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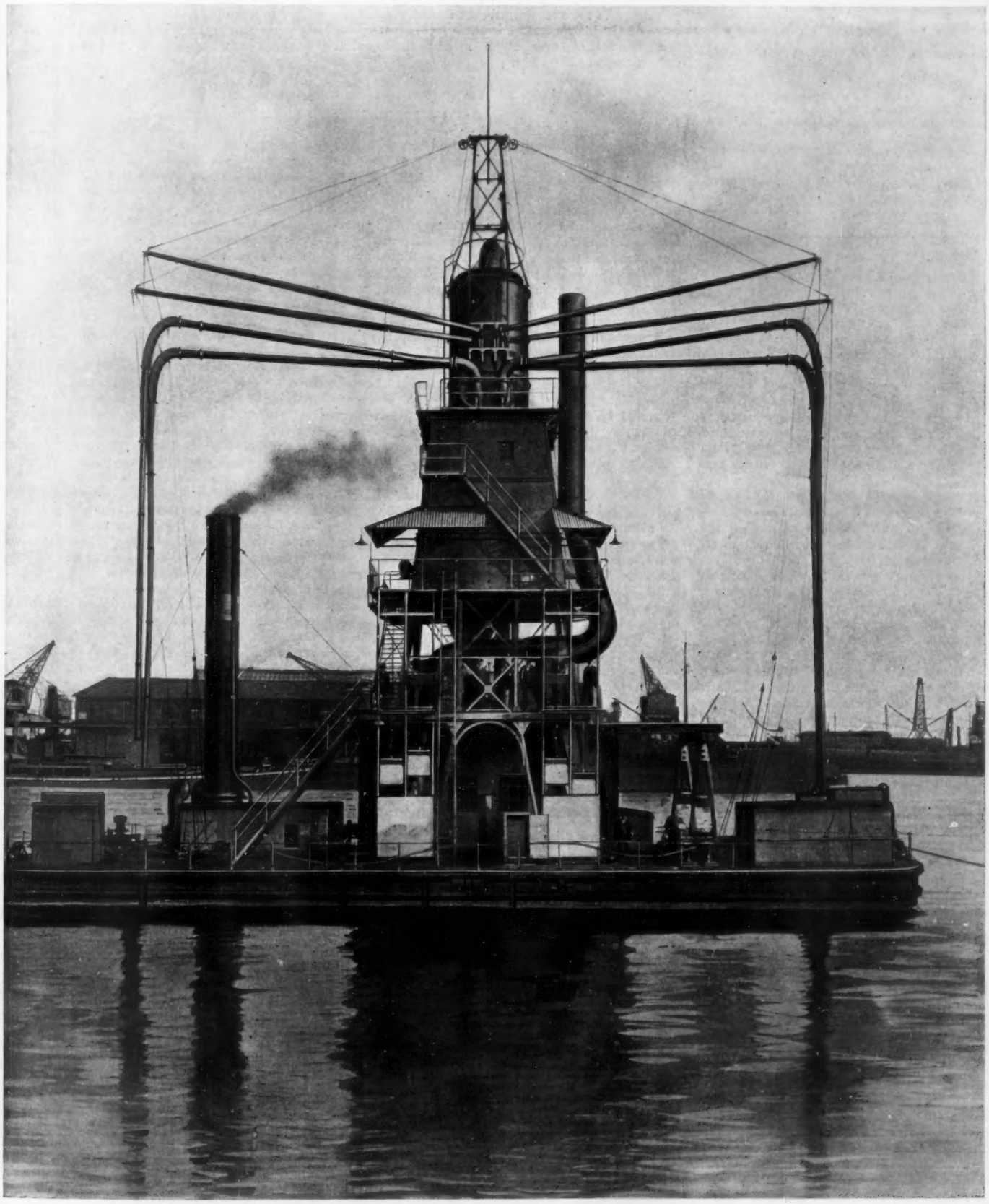

Grain installation fixed on a floating pontoon, recently placed in service at Emden on the North Sea.

A FLOATING PNEUMATIC ELEVATING AND GRAIN DISCHARGING PLANT.—[See page 48.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Government Valuation of Railroads

THE ruling of the Supreme Court in the Minnesota rate case, which establishes the right of the States, where there is no Federal intervention, to regulate railroad rates within their own borders, has aroused an inevitable fear among the investors and managers of our railroad systems that great injustice may be wrought in certain directions to the investors, and that the further development of our transportation facilities may be greatly retarded if not practically arrested.

Take, for instance, the ruling of the Supreme Court that the value of the right-of-way shall be determined by the current market value of similar land in its vicinity—a ruling which if applied on hard-and-fast lines cannot fail to work very great injustice. Any one who has been concerned in the construction of new railroads is well aware that the owners of lands through which the projected line is being laid are apt to ask exorbitant prices for the property that is required for right of way, leaving to the railroad the choice of paying the price or resorting to the delay and expense of condemnation findings approved by the court.

We are well aware that in the building of pioneer railroads, cases have occurred where the desire of the public to obtain the advantages of railroad transportation has led to an offer of a free right-of-way, should the railroad be built, but we believe that these cases are comparatively rare; certainly liberality of this kind is not conspicuous in the later development of existing railroads, particularly in the more populous parts of the United States. It is evident that if valuations are to be made in strict conformity to this ruling of the Supreme Court, a grave injustice may be done the investor and the attitude of the Government may become almost confiscatory in character.

Furthermore, we fail to understand on what basis of law or equity the court should have ruled that, in estimating the value of right-of-way, the interest charges, cost of acquisition and various contingencies should be excluded. Particularly in the case of some of the recently built and extremely costly roads, it can be proved that these expenses are very real and of large amount. Capital is proverbially timid, and we can conceive of no conditions that would discourage the investor more effectually than the realization of the fact that at some subsequent day, in valuing the property covered by his investment, the Government might refuse to recognize the large sums of money which had to be invested in excess of land values in the immediate neighborhood.

In its ruling on the question of depreciation of values, the decision of the Supreme Court runs counter to well-established accounting practice, which has been to charge repairs and renewals to income and not to capital; and it seems to be opposed furthermore to the previous rulings of the Interstate Commerce Commission. By common consent, depreciation has been considered a liability of the stockholder, to be provided for from reserve funds and current earnings—certainly it has never been regarded as a wastage of capital. One of our leading railroad men, commenting on the injustice of this ruling, quotes, once more, the familiar illustration of the ferryboat, which represents an investment, say, of $20,000 in a craft which having a life of 20 years is entitled to a return of 4 per cent annually for that period, and also operating expenses and an amount each year which, in the aggregate, with interest, will amortize the investment at the end of the twenty years. According to the ruling of the Supreme Court, at the end of the nineteenth year the owner of the ferryboat should be entitled to a return on the depreciated value of the boat only, or say $1,000, instead of the full investment.

A savings bank investment would be better than this.

Some day, in a more remote future than its advocates would have us believe, Government ownership of railways may receive national approval and be made the subject of an act of Congress. We speak of the remote future, because we believe that the purification of our political life, of which there are encouraging signs, has not yet proceeded to the point at which our great and costly railway system can be safely intrusted to the tender mercies of political appointees. A question of such vast importance as that of Government control of the railroads should be approached in a most conservative spirit, and with a keen sense of the high moral obligation of the Government to act in a fair and broad-minded spirit in the appraisal and purchase of these vast properties.

A Word of Warning

THE daily press states that the British Navy has committed itself to the policy of oil fuel to the exclusion of coal for ships of all classes and sizes; also, the daily press and certain engineering journals make it apparent that the United States in the design of its latest battleships is providing for oil burners only.

It is inconceivable that Great Britain, owning no extensive oil fields, should commit herself irrevocably to this policy, and it is not believed that the United States Navy has so committed itself. We believe, rather, that the United States Navy desires simply to experiment in oil burning, and that its action in the case of the three or four most recent ships is not to be regarded as a precedent or as a fixed policy. This belief is based on the well known fact that while the United States is in a better position as to a supply of oil fuel than is Great Britain, still the Government controls very little oil-bearing land of known value. The opinion expressed by some experts as to the total known and probable supply of oil is that it scarcely equals five per cent of the total known and probable supply of coal. It is also to be remarked that the oil supply is owned and controlled largely, if not exclusively, by well nigh all-powerful trusts, who are able to manipulate the prices to suit their convenience, or to withhold the supply absolutely if they see fit.

The records of oil prices show that, whereas fuel oil could be had at about 2¼ cents a gallon three or four years ago, it now costs from 4½ cents to 4¾ cents per gallon. These prices may be accounted for by the fact that at the first mentioned date there had already been developed a large demand for gasoline, naphthas and other lighter fractions, so that the residual (about 50 per cent of the crude oil) represented a by-product for which there was no very great demand. Under these circumstances, the oil interests did everything humanly possible to encourage and develop the advantages of burning oil for fuel, both in land and marine installations. Their arguments were that oil burners required less attendance, less space for stowage, no handling of refuse, a quicker response to steaming demands and that the fuel was actually cheaper than coal. These very attractive arguments won the day and caused many new plants to be equipped for oil burning and many old plants to be converted from coal burning to oil burning.

The action of the Standard Oil Company and its subsidiary companies in the fall of 1912, by which they refused to renew contracts with large customers and failed to deliver the required amounts under the then existing contracts, shows conclusively that the demand for crude oil and residual oil as fuel is now apace with the demand for the lighter fractions, so that the future effort of the oil interests will be to refine only a sufficient amount of oil to so supply the demand for gasoline and naphthas as to keep the price of these products at the highest possible level. There will necessarily result an ever increasing shortage in the supply of fuel oil, both residual and crude, so that we may expect a continual increasing price on this product. In fact, cost of fuel only considered, it now costs more to produce a horse-power by burning oil in the furnace of steam boilers than it does by burning coal, and the end is not yet in sight.

It is believed that the United States Navy should build its capital ships primarily as coal burners, providing oil stowage simply as an adjunct. The cost and availability of fuel are the only questions that need be considered, so far as the Navy is concerned, since the complement of a war vessel includes a sufficient number of men to handle the fuel and the refuse under ordinary cruising conditions. The military value of having a supply of fuel oil to be used as an auxiliary rests in the fact that the limit to high speed steaming is the failure of the personnel to get the coal to the furnaces. Hence, it is very desirable that the crews of vessels have sufficient experience in oil burning, so that in an engagement or chase at high speed, after the crew has become exhausted in firing with coal, the use of oil may be resorted to and the personnel relieved, enabling the vessel to continue at high speed.

It seems, therefore, that capital ships should not be designed as oil burners, since a ship so designed cannot go to coal burning without a complete re-arrangement of firerooms, boilers and furnaces. On the other hand, a ship designed primarily as a coal burner can use oil as an auxiliary without requiring any structural re-arrangement.

Interstate Commerce Commission on the Stamford Wreck

WE have before us the report of the Interstate Commerce Commission on the rear collision at Stamford, Conn., on June 12th, in which six passengers were killed and twenty injured. The findings are based upon an impartial review of the facts as brought out in evidence and they will commend themselves to every one who has made an intelligent study of the question.

Rear collisions are common enough—sadly too common—on American railroads; and it may be asked why we select this particular collision for special comment. We do so for the reasons that the circumstances of the wreck are unusual and that they teach some valuable lessons which are summarized in the report before us.

Rear collisions are due generally to disregard of, or inability to see signals, or to disobedience to train orders. The present collision took place in day light, when the conditions for vision were good, the signals were properly set, and the engineer was doing the best he knew how to obey the signals and avoid collision.

We are entirely in agreement with the conclusion of the report that the engineer did not have the special experience and instruction required for the operation of such a train. It takes judgment and experience to enable the engineer of a heavy passenger train running sixty miles an hour to determine just when and how to apply his brakes in order to stop within a determined distance. In such experience the engineer of this train was totally lacking. Work as a fireman, or an engineer handling freight and even slow passenger trains, would not give him the necessary experience. In this connection reference is made in the report to the testimony of the airbrake expert of the Pennsylvania Railroad, who said that if it had been found necessary to send such an inexperienced man out on such a train, a traveling engineer, or a road foreman of engines, would have been assigned to ride with him.

The report lays stress upon the fact that when this engineer on his first trip in charge of a first-class passenger train, ran by a station and reported that the error was due to the brakes being out of order, no one in authority seems to have seen any necessity for a test, either of the man or the brakes, before he was again sent out on the same line of service. We must confess that it is simply amazing that the first run of a new and inexperienced man with an important train was not the subject of careful supervision, and that his failure to properly brake his train, and the reason he assigned for his failure, should have been overlooked by the company. Such carelessness justifies the report in stating that something is "out of gear" on a railroad where high-class trains may be given over to an uninstructed engineman.

With regard to the condition of the equipment, the statement of the engineer as to something being wrong seems to be verified by the evidence of an expert from the Lackawanna road, who stated positively that a train in the condition in which this train was found at the time of test (subsequently made) would not have been permitted to leave the terminal of his road in fast passenger train service. The Commission finds that the railroad has no proper system of checking work reports, so as to determine whether or not the defects reported on locomotives are actually repaired. It seems incredible that such laxity could be possible on a modern first-class railroad. It was an invitation to such disaster as occurred.

The whole system of swiftly flying and extremely heavy trains is safe from collision as far as the equipment is concerned, only if the Westinghouse air-brake is in perfect condition. This fine piece of mechanism, one of the most brilliant and successful inventions of the age, will do its work effectively, only if it is maintained in first-class condition. But like many another successful invention, it requires a thorough system of inspection and maintenance, and it is well understood that careless and too infrequent inspection and cleaning may rob the air-brake of a great part of its effective braking power. On any well organized road, any report from an engineman of the slightest defect in the brakes would receive immediate attention.

Engineering

Proposed Tunnel Beneath the Solent.—It is proposed to build an electrically operated subway connecting the Isle of Wight with the main land. The length of the line will be some four miles, and the route will be in a direct line between Stokes Bay on the mainland and Ryde on the Island, the crossing lying a little to the east at the point where passengers for London disembark from the German steamers. The total estimated cost is $3,750,000.

Panama Canal Excavation in May.—The total excavation for May, at the Panama Canal, of 2,779,532 cubic yards brings the grand total of canal excavation for the first time beyond the 200,000,000 cubic-yard mark. There then remained to be excavated 17,401,167 cubic yards. The total for the month is made up largely of dry excavation in taking out the Culebra slides and of wet excavation representing the work of the dredges at the two sea-level entrances to the canal.

Solve This Problem.—The largest transatlantic liner now under construction will present to a head wind a cross-sectional area above water, including smokestacks, masts, etc., of about 9,500 square feet. If the ship were steaming at a reduced speed of 15 knots against a head wind of 65 miles velocity, how much horse-power would be necessary to overcome the wind pressure alone? We submit this problem to our readers.

A Diesel-engined Ship for American Service.—The placing of the "Hagen," which is driven by Diesel engines, in service from Port Arthur to Kingston and Toronto is of interest to the engineering world because this is the first large Diesel-engined ship to enter the American service exclusively. The "Hagen" is driven by an 850 horse-power Carels-Diesel, two-cycle marine engine. The ship made the Atlantic passage in 17 days, 21 hours, developing 800 horse-power at 97 revolutions and using three and one half tons of fuel per day. An excellent feature of the engine is the maneuvering ability, as shown in the builders' trial, when the vessel made 63 maneuvers in 41 minutes, reversing from full speed ahead to full speed astern, qualities which were again demonstrated at Montreal, when the ship was maneuvering through the locks in the canal.

One Way to Prevent Fire Losses.—Residents in New York will remember the campaign of education which took place last year under the direction of Fire Commissioner Johnson. The movement took the form of a series of photographs of rooms, houses, and apartments in which there was practically no furniture whatsoever, but upon which policies had been issued; and it was intended to point the moral that the indiscriminate issuance of policies made the firebug's business a most profitable one. The greater care exercised in the first six months of the present year by the fire insurance companies has been mainly responsible for a reduction, during this period, in the total fire loss, of $2,382,686. The Commissioner estimates that the saving in wear and tear on the department apparatus due to a reduction of 1,850 fires has brought an additional saving of $129,500 to the city.

Excellent Sanitary Conditions at Panama.—That the Isthmus of Panama continues to present sanitary and health conditions comparable to those of the average city in the United States is shown by the report of the Department of Sanitation for the month of May, during which the annual average death rate among employees per thousand reached the low figure of 7.63, of which 5.42 were due directly to disease. The annual death rate per thousand in the cities of Panama and Colon and the canal zone, including both employees and civil population, for the month of May was 19.66. Comparison of these figures should be made with those for the year 1907 when the total death rate was 30.15 among employees and the annual death rate for both employees and civil population in the cities of Panama, Colon and the canal zone was 31.67. In the preceding year, 1906, it was as high as 43.32.

Value of Large Fireboxes and Superheat.—We have received from the Baldwin Company a diagram illustrating the reduction in tractive force with increasing speed for Consolidation and Mikado types of locomotives. At a speed of 30 miles per hour, the Mikado type develops 50 per cent of its maximum tractive force, as compared with 35 per cent for the Consolidation. This superiority is due in part to the generous dimensions of the furnaces in the Mikado type and the complete character of the combustion of the furnace gases, and in part to the use of superheated steam with its reduction of cylinder condensation and other economic advantages. The Mikado type using superheaters, built by this firm, where they have taken the place of Consolidation engines using saturated steam, are hauling 30 to 45 per cent more tonnage per train with no increase in actual coal consumption, a truly remarkable result.

Science

The Improved Telegraphone.—A new form of Poulsen's telegraphone has been patented in which a thin wire of tungsten steel is made to run rapidly between the poles of a small electro magnet in the receiving circuit of the telephone. In order to magnify the sounds a Brown telephone relay may be employed.

The Aerological Observatory in Teneriffe, recently established under the auspices of the International Commission for Scientific Aeronautics, has been taken over by the Spanish government and placed under the direction of Señor Juan Garcia de Lomas Lobaton. Additional stations are to be established at lower levels in the island.

Changes in the Map of Africa.—The territory in northern Africa, recently conquered by Italy from Turkey, has been divided into two distinct colonies, viz., Tripolitania and Cirenaica, with capitals at Tripoli and Bengasi, respectively. A governor for each colony is to be appointed by the King of Italy upon the joint recommendation of the ministers of Colonies and of War.

Electrification Associated with Dust-clouds.—Prof. W. A. Douglas Rudge publishes in the *Philosophical Magazine* the results of elaborate investigation showing that nearly all kinds of finely divided material when blown into a cloud by a current of air give rise to electrical charges upon the dust and upon the air. The nature of the charge resident upon the dust particles depends upon the chemical characteristics of the material.

The Ninth International Congress of Hydrology, Climatology and Geology will be held at Madrid, October 15th to 22nd, 1913, under the patronage of H. M. the King of Spain. An international exhibition comprising appropriate scientific material will be held in connection with the congress. The congresses of this series deal mainly with the medical aspects of the sciences in question.

Experiments with Ripples.—At the recent conversazione of the Royal Society, Prof. L. R. Wilberforce showed how ripples may be produced on a water surface by a vibrating dipper and projected by intermittent light so as to appear stroboscopically in slow motion. A phonic wheel drove a slotted disk which produced the intermittence, the motion being transmitted by fluid friction, whereby a very uniform rotation was obtained.

Prof. Rockwood Dead.—Dr. Charles Greene Rockwood, Jr., Professor Emeritus of Mathematics at Princeton since 1905, died on July 2nd. Prof. Rockwood was born in New York in 1842, the son of Charles G. and Sarah Smith Rockwood. He was graduated from Yale in 1864, receiving his Ph.D. degree there in 1866. He received the degree of A.M. from Yale in 1867, from Bowdoin College in 1869 and from Princeton in 1896.

A Novelty Among Agricultural Experiment Station Bulletins has just been issued by the station of the University of Wyoming at Laramie, entitled "The Identification of the Woody Aster" (Bulletin No. 97, April, 1913). The bulletin is printed on a sheet of cardboard, folded once to make four pages. The first (cover) page and the last page contain photographs of the plant in question, which is poisonous and has caused the death of thousands of sheep in Wyoming; the second page contains a non-technical description; while on the third page is mounted, in herbarium style, an actual specimen of the aster, in blossom.

"The Barocyclonometer for Use in the North Atlantic" is the title of a pamphlet by Rev. José Algué, S.J., which has just been published by the Philippine Weather Bureau at Manila. An account of this instrument in its original form, as used for many years past by mariners in the Far East for the purpose of determining the proximity, direction and movement of typhoons, was published in the SCIENTIFIC AMERICAN of October 19th, 1912, p. 326. It has been materially modified by its inventor for use on the Atlantic.

Measuring the Stress Distribution in Transparent Materials.—Prof. E. G. Coker has devised an apparatus for measuring the principal stresses at any point in a plate subjected to plane stress. This he accomplishes by measuring their sum and difference separately. The sum is proportional to the change of thickness of the plate, and is measured at any section by a special form of extensometer reading to half a millionth of an inch. The difference at the same section is obtained from observations of the color bands shown in polarized light.

Lindenberg Observatory, the premier aerological institution of Europe, on December 31st, 1912, completed ten years of daily upper-air observations with kites and captive balloons. In spite of every variety of unfavorable weather, including furious gales, heavy fog, severe thunderstorms, ice deposits on the kite-wires, etc., observations were not omitted on a single day of that period, and the total number of ascents amounted to 5,659. No other observatory in the world approaches this record. During the first two of these years the ascents were made at Tegel, the original site of the observatory. Besides the routine daily observations above mentioned numerous ascents of pilot-balloons and sounding-balloons have been made.

Aeronautics

The First Aeronautical Scholarship has just been won by a student at St. John's elementary school, Ealing, England. The scholarship is the gift of Mr. Grahame-White, and entitles the holder to three years' aeronautical training at Hendon.

Zeppelin to Attempt Transatlantic Flight.—Count von Zeppelin is building his largest dirigible with a view to crossing the Atlantic to the United States in the late summer. He expects to make the trip in from thirty to sixty hours' time. German warships are to be distributed along the course to assist the airship in case it is obliged to descend.

Supporting Wheels for Aeroplanes.—Harry A. Orme of Wesley Heights, D. C., has secured a patent, No. 1,065,389, for an aeroplane in which the wheels are mounted in frames which are pivoted to the plane of the aeroplane so that they can swing outwardly in opposite directions, means being provided for elevating the wheel frames outwardly and laterally in the operation of the apparatus.

Equilibrium Device for Flying Machines.—Frederick William Dufwa of Mexico, has patented No. 1,065,033, an improvement in flying machines in which a rudder is mounted to swing sidewise and a swinging car is connected by a flexible connection with the rudder so that a side dip or inclination of the machine will automatically swing the rudder to re-establish the equilibrium.

An Aeroplane Improvement.—Halvor Olsen Eiane of San Diego, Cal., has patented an aeroplane in which there is provided in connection with a frame, a horizontal adjustable plane which may be adjusted by means of spaced vertical planes which are mounted for bodily movement in a lateral direction by the air and are operatively connected with the adjustable horizontal plane. The patent is No. 1,062,772.

New Steering Gears for Aeroplanes.—In patent No. 1,062,055, to Rene Tampier of Paris, France, is shown a steering mechanism for aeroplanes in which the rudder is capable of movement about a vertical axis and about a horizontal axis and also about an oblique axis which is itself movable, the rudder being controlled in its several movements by means of two hand wheels and bearing mounted at three triangularly arranged points so it can be actuated as above described.

An Aeroplane Flight from England to India will, says the *London Times*, be attempted next October by Mr. G. M. Dyott, who is now making cross-country flights in South America; the undertaking being, however, contingent upon the completion of a guarantee fund, which now amounts to about £1,000. The proposed route is by way of France, Sicily, Alexandria, Cairo, Khartum, Suakin, Aden, and Karachi. At the end of the flight it is proposed to present the aeroplane to the Government of India.

No Royalties on Wright Machines.—It does not seem to be generally known that the Wright Company no longer charges royalty for the use of their machines for exhibition flying. As a matter of fact no flying royalties have been charged since January 1st, 1913. The Wright Company has decided, because of the greater competition in the exhibition business this year, to give their patrons still greater advantage by discontinuing the royalty charge for exhibition work. This means that the purchaser of a Wright machine will have the free and unrestricted use of the machine.

A Texas Flying Machine Patent.—In patent No. 1,056,772, Frank M. Bell of El Paso, Texas, shows a flying machine of biplane form with two engines located below the lower plane and two concentric propeller shafts each equipped with a propeller and located between the two planes with gearing from the engines to the shaft, and each engine operable to drive the corresponding shaft and propeller independent of the other engine and propeller; also a vertical shaft with a propeller and a clutch for connecting one of the engines to drive the vertical shaft, both planes having openings in line with the propeller on the vertical shaft and through which openings the air may pass freely when the machine is moving up or down.

Pilot Statistics.—The International Aeronautic Federation has recently published its annual bulletin, and it contains a list of aeronauts in all countries who are regularly entered. Up to the end of last year the number of aeroplane pilots is as follows: France, 968; Great Britain, 376; Germany, 335; United States, 193; Italy, 189; Russia, 162; Austria, 84; Belgium, 68; Switzerland, 27; Holland, 26; Argentina, 15; Spain, 15; Sweden, 10, etc. Pilots of spherical balloons are as follows: Germany, 909; France, 264; Austria, 86; Italy, 67; Belgium, 55; United States, 42; Great Britain, 32; Switzerland, 30; Spain, 30; Holland, 17; Sweden, 17; Argentina, 13, etc. As to pilots of airships, the number is: Austria, 24; France, 23; Germany, 22; Italy, 13; Great Britain, 11; United States, 3, etc.

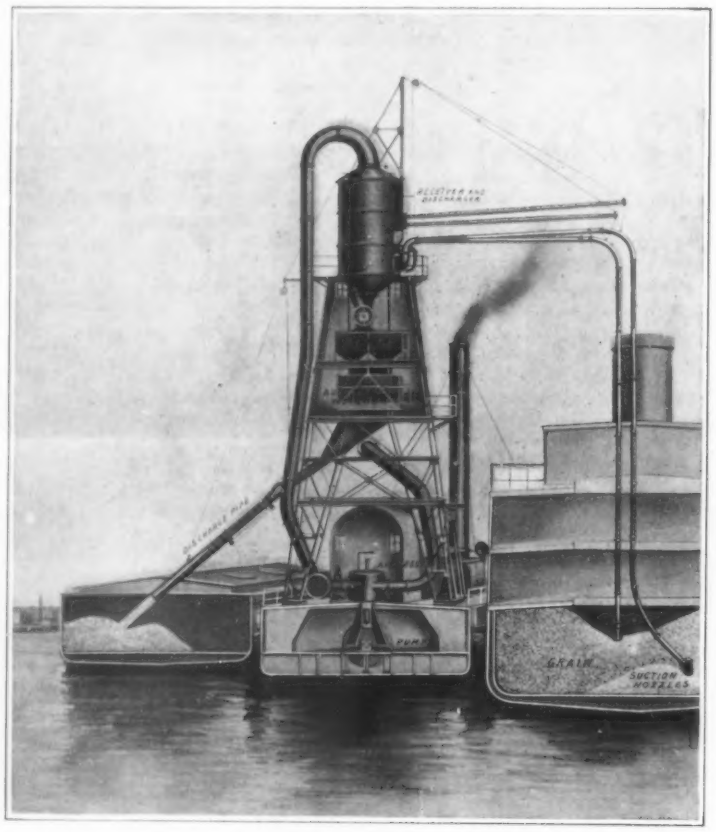
A Floating Pneumatic Elevating and Grain Discharging Plant

By Frederick C. Coleman

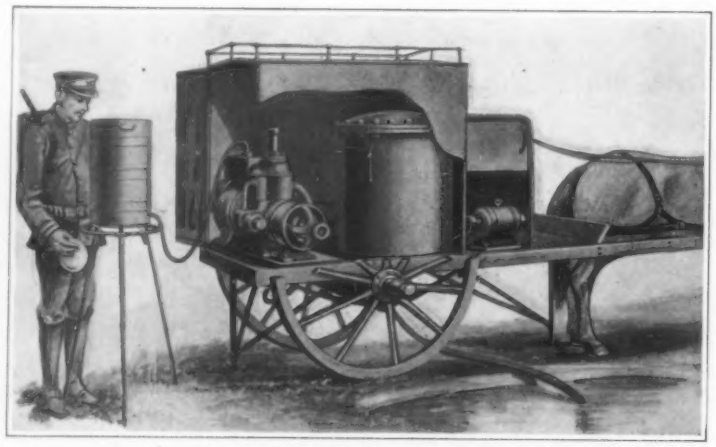
AN interesting floating pneumatic elevating and discharging grain installation has just recently been put into service at Emden, the rapidly-developing German port on the North Sea at the mouth of the river Ems. The elevator, which was built by Messrs. Gebruder Seek of Dresden for the Elevator Gesellschaft of Emden, is illustrated in the photographs and consists of a floating iron pontoon, in which there are divisions for boiler and engine installations, together with living, kitchen and lavatory accommodation for the staff, and ample storage room for materials. The machinery installation in the pontoon consists of one compound vertical steam engine, connected with the necessary air pumps of vertical type to which they are direct coupled. The speed of the steam engine can be varied even when running by means of a hand wheel and regulator on the shaft. In the same room as the steam engine for driving the pumps are the condensation apparatus, the Lenz and boiler feed pumps and a special engine for the production of light and power, which is also of vertical type and coupled direct. There is also a third steam engine with a belt drive for a small dynamo to produce electric energy for power purposes. The engines, pumps and gears receive their steam from the boiler, arranged close to the engine-room, and work at a pressure of 12 atmospheres. To the left and the right of the boiler-room are the coal stores and the water tank from which the boilers are fed. Above the engine room is the iron mast which carries the pneumatic transport apparatus and weighing machines. As may be gathered from our illustrations, a portion of the mast is covered with sheet iron and is provided with staircase, platform, windows, doors, etc., and the whole is well fixed to the floating pontoon. On the top of the tower, at the platform level, are placed the receiver and discharger of the transport installation, and to these are connected four carrying tubes which are made movable both vertically and horizontally, and are fitted at the ends with suction nozzles so that the amount of air carried up with the grain can be regulated to a nicety. Pipes are then led from the receiver to the pumps and air vessel, which are fixed on the side of the tower.

To meet delays which might occur during weighing operations or by disturbances in the air lock, there are provided inlet valves as well as automatic safety valves, arranged in the air tubing and air chamber, which come into operation when the normal working pressure is exceeded. In the air chamber is also an arrangement to prevent grain being carried over into the same. To prevent any dust entering these there is arranged in the interior of the receiver and discharger a patent dust-collecting arrangement. This separates the dust from the grain, and allows them to mix only after the latter has passed through the vacuum chamber of the receiver. A special advantage of this arrangement is that complicated cloth or water filters are avoided, and thus there is a great saving of space and labor. The whole installation is very simple and entirely automatic. Below the receiver is the discharging device, which is adjustable and driven by an electric motor. The current is regulated by a switchgear, set at a specified resistance, and if this is exceeded (which happens under abnormal conditions) the power is automatically switched off so that both discharger and motor stop working. Beneath the discharging device an iron hopper is arranged with a double slide, from which the grain is fed into an automatic weigher. Thence the grain is brought into another hopper and then by means of telescopic tubing it is discharged into small boats.

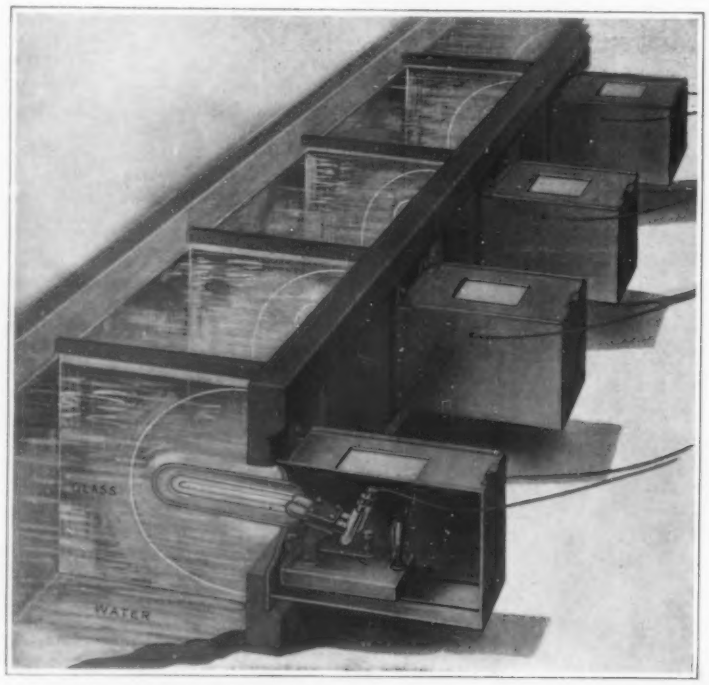
The plant is arranged to take a sacking machine of a capacity of 50 tons per hour, and will empty steamers and load lighters (in bulk) at the rate of 120 tons in the same time. In all working and living compartments of the elevator, electric lighting and steam heating are provided, and the signaling arrangements for communicating between the different working positions are specially designed.



View showing elevation of the floating grain discharger operating in the pneumatic transportation of grain.



Ultra-violet light water sterilization apparatus for army use.



A municipal ultra-violet light installation for the sterilization of drinking water.

Purifying Water by the Action of Ultra-violet Light

By Dr. M. von Recklinghausen

IT is highly important that a good drinking water shall be free from microbes, because many disease germs, such as the bacteria of typhoid, cholera, etc., are transmitted by water. A single person has caused infection to springs with typhoid and thus caused epidemics in which many people died. Hence modern hygienics demands, first of all, sound drinking water for public distribution as well as for private use. Many springs deliver good wholesome water, very low in their microbic contents, particularly in *bacterium coli*. How can these sources deliver pure water if they are supplied with water from rivers or effluents heavily charged with the refuse of towns and villages? Simply by following the methods of nature. Nature employs two means for purification. The first is the action of sun or daylight on the microbes floating in the water. It has long been known that the sun has so strong a bactericidal effect, that rivers are purified some miles below the entrance of city effluent, so that the water contains scarcely more microbes than before entering the city.

The second means employed by nature for purifying water, is filtration over natural sand beds, such as river alluvials, thereby mechanically freeing the water of suspended matter and of germs.

Until recently only the latter process has been artificially employed. For nearly eighty years water plants have been provided with sand filter beds so that the water which they deliver is nearly always physically good. In other words, it is free from suspended matter. Bacteriologically, however, the water is not always up to the standard which modern hygienics demands. For instance, Miquel, the famous French water hygienist, demands for water of the very best quality a microbic content not higher than ten per cubic centimeter. And the number of *bacterium coli* must not exceed ten per thousand cubic centimeters. To obtain such results the first one of the above mentioned natural methods of killing microbes is now practically applied; namely, exposing water to a strong light. The strong bactericidal or sterilizing action of the sunlight is due to the ultra-violet rays in the solar spectrum. Hence, we must choose a light which is extremely rich in these ultra-violet rays. We must create a miniature "artificial sun." In the quartz mercury vapor lamp, which closely followed the fundamental work done by P. C. Hewitt in illuminating mercury vapor lamps, such a source of ultra-violet rays has been found.

Purification, or sterilization, of water by ultra-violet rays has become increasingly important within the last three years. The principles which form the basis of the water sterilization by mercury quartz lamps are as follows:

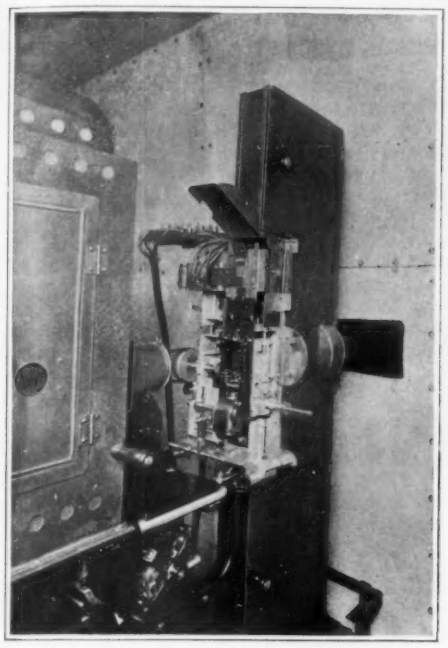
First. Water, being easily penetrated by ultra-violet rays, may be exposed in a thick layer to the rays. But the water must be free from floating matter. Usually it must first be filtered.

Second. The apparatus must be so arranged that the ultra-violet rays are produced with a minimum of electric energy; also the ultra-violet ray lamps must have an economical life.

Third. The apparatus must be so constructed that the maximum amount of ultra-violet light enters the water. In other words, as little light as possible should be lost.

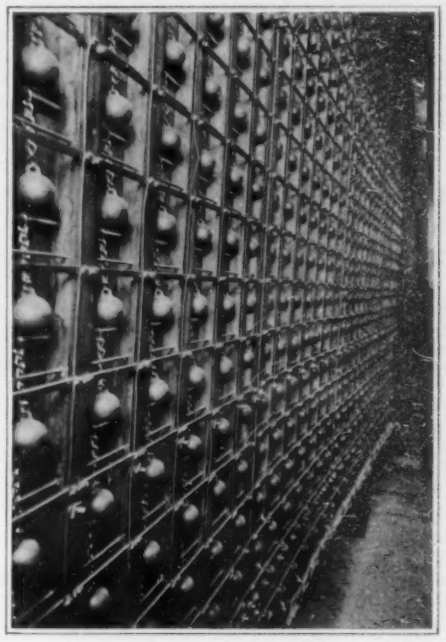
Fourth. The apparatus must be so constructed that the water passes under the influence of the strong light several times. This is effected either by leading the wa-

(Concluded on page 57)



Projecting mechanism, showing the fingers that make contact through perforations in the film.

Riflemen's counter, with a panel removed to show the recording mechanism; recording lamps at the left.



Rear of the steel screen, showing the steel balls that close the electrical circuits.

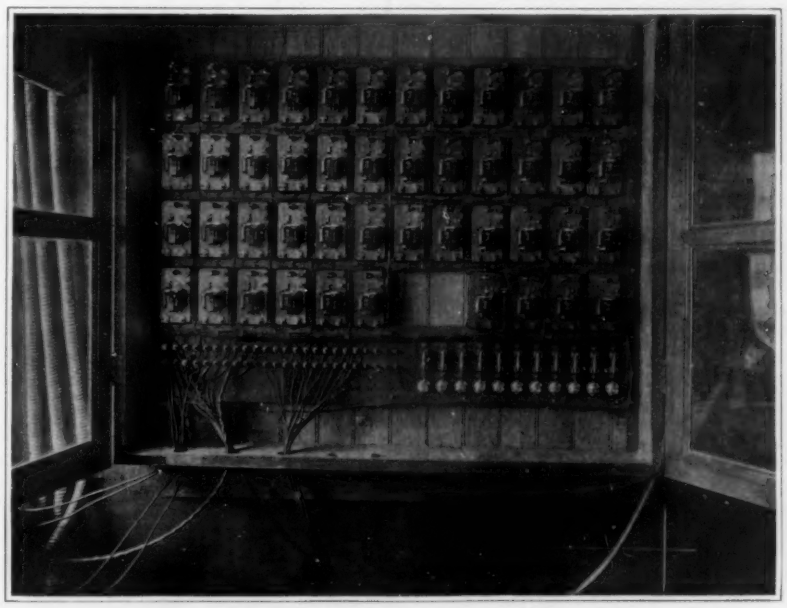
Shooting at Moving Pictures

WILD game hunting with no game warden about and open season all summer can now be enjoyed by the city-bound hunter. The happy hunting ground is at Coney Island, where moving picture animals in realistic settings scamper across the far end of a shooting gallery for the accommodation of aspiring marksmen. The only departure from realism is that the animals do not fall dead when shot, but by a very ingenious mechanism a record is made of the hits, and the scores of the different rifles are kept separately.

Two weeks ago the SCIENTIFIC AMERICAN described the moving picture targets used for the training of sharpshooters in the British army, in connection with which a sound actuated mechanism is employed to arrest the projecting lantern for an instant as soon as a shot is fired, so that the result may be determined by noting the tear in the screen. The fundamental difficulty with this system of moving targets lies in the fact that the animals appear to move, whereas they do not actually move, but are merely seen in different momentarily fixed positions. For instance, an animal which occupies a certain position in one picture may in the very next picture occupy a position several inches away. The eye supplies the illusion of moving from one spot to the other, while the picture animal does not actually traverse the distance. If the rifle is fired when the animal appears to occupy a point intermediate between the two actual positions, it will strike the screen between pictures, and a miss will be recorded. This difficulty has been very successfully overcome in the system illustrated in the accompanying engravings, the inventor of which is Mr. Eliot Keen.

The screen on which the pictures are projected is a steel plate about eight feet square and painted white. At the back of this plate a wooden gridiron supports small iron balls hung on short pieces of chain arranged so that the impact of the bullet on any point on the steel screen will drive a ball away from the plate, causing the chain to cross two rods, thus closing a break in an electric circuit. Only the rods immediately behind the target are energized, so that a hit will be electrically recorded if the bullet strikes the target. Otherwise the apparatus will show a miss. One of the accompanying photographs shows the back of the steel screen with the balls attached to it and the rods running across it. The balls are three inches apart. The rods run horizontally, but every other one is connected with a vertical wire. We may liken the horizontal rods to parallels of latitude and the vertical wires to meridians or lines of longitude, by which any spot on the screen may be fixed, just as on a map. Having determined the latitude and longitude of the different points that will be occupied by the target, it only remains to provide means for energizing the vertical and horizontal lines crossing at these points at the particular moment when they will be traversed by the moving target. This is done by using sets of contact fingers on each side of the film in the projection mechanism and cutting perforations in the film through which various combinations of fingers may make contact to close the circuit of the corresponding parallels and meridians of the screen.

As shown in one of our illustrations there are nine fingers on one side to control the parallels and nine fingers on the other to control the meridians. These fingers operate in pairs of various combinations to close the circuit of relays which in turn operate to energize the corresponding rods. By using intermediate relays, nine fingers are enough to control three or four times as many rods.



Relay board actuated by the contact fingers and energizing the rods behind the screen.

In preparing a film it is thrown up by means of a weak light upon a chart which shows the location of the wires and the balls of the large target board. The operator looking at the projected image of the first picture of the film sees by the chart what wires must be connected to the current to sensitize the animal in the picture. Having determined its latitude and longitude, the edge of the film is correspondingly perforated with two holes on each side, then the next picture is similarly treated, and so on until the entire tape has been perforated. Only a momentary impulse may pass through the fingers because the film comes to rest for but an instant, and then moves on, breaking the electrical contact through the perforations. Accordingly a device is provided which automatically keeps the rods energized until the next impulse is passed through the fingers as they drop through the perforations of the succeeding picture on the film. The "vital" spot on the animal never passes out of the sensitive area on the screen. It is not to be supposed that a bullet must actually strike the steel curtain at the very point behind which the ball is resting. There is no spot on the screen that is dead. If a bullet should strike midway between two balls both of them would be thrown outward, making contact with their respective rods. Thus between two successive positions of the animal, and through which by the illusion of the kinematograph the animal appears actually to move, the screen is sensitive, and should a bullet strike any intermediate spot, a hit would be recorded. In other words, there is never a time when the illusion makes it impossible to score a hit.

The hits and misses of each marksman are recorded by a series of lamps located before and above him. The circuit to these lamps is closed through his own gun. Electrical connections to the different guns are made through a light flexible cord which does not interfere in the least with the shooting. The contact is made at the hammer when the gun is cocked and broken when the gun is fired. An electrically operated ratchet device steps a brush from the terminal of one lamp to the terminal on the next lamp circuit. A timing device is used to operate a circuit breaker. Every rifle is connected to its own "stepper" and scoring lamp. When the gun is fired, the timing device closes the circuit connecting the particular gun with the steel target contacts for a fraction of a second. If the shot is a hit during this interval an impulse lights the lamp by throwing a switch. If the shot is a miss the timer cuts the connection after the proper interval and the lamp stays dark. The gun cocked for the next shot steps the brush to the next lamp and so on. Any number of rifles can be used, for the interval required for an impulse to reach the lamp of each gun is hardly appreciable.

Automobiles of the Paris Fire Department.—The Paris fire department intends to double the capacity afforded by its present automobile fire engines, by the use of fifteen automobile fire pumps which will be of a lighter design than the ones already in use. The new engines will carry six men instead of fifteen. On the wagon truck is mounted a 100-gallon tank so as to afford an immediate water supply for the hose so that a stream can be put on the fire at once, while the connection is being made with the fire plug. This type of light engine is especially intended for fighting moderate-sized fires during the daytime. The number of automobiles used by the chief firemen is also to be increased.

Wireless and Sound Signals as Aids to Navigation

By Louis E. Browne

EXPERIMENTS recently conducted on board the United States steamship "Washington," in the vicinity of Nantucket Shoals lightship, for the purpose of demonstrating the practicability of determining distance from a source of simultaneous wireless telegraphic and sound waves as a means of facilitating navigation in foggy weather, have been accepted by the Navy Department as conclusive proof that this system, in time, can be developed to a high degree of perfection.

The morning during which the experiments were made was very hazy, but Nantucket Shoals lightship could be dimly seen for about five miles. The barometer stood at 30.11 and the sea was calm. Starting near the lightship, a course was steered to the westward for a distance of eight miles, and then, turning to the southward and proceeding east, the lightship was passed on the port beam at a distance of 3,450 yards. Standing on for eight miles more and then turning to the northward, a northwesterly course was pursued, passing the lightship on the port beam at a distance of 4,600 yards. Then, turning southward, the "Washington" approached and passed near the lightship on a southwesterly course at the close of the observations.

The track of the "Washington" in relation to the lightship is shown on the accompanying drawing by a continuous black line, which was determined by the range-finder method, compass readings, and distances run, after making careful allowance for the tidal current that was found to be setting generally to the northward during the experiments.

Signals from the lightship consisted of simultaneous signals from the wireless-telegraph apparatus and the submarine-bell at the instant when the steam fog-whistle gave a blast. At intervals of one minute—the maximum interval at which the timing device attached to the whistle permitted it to act—a sound blast was blown from the fog-whistle. At the instant the whistle blew, the wireless operator flashed a tick of two or three seconds duration, and the valve of the striking mechanism of the submarine bell was tripped. This was accomplished with absolute accuracy, for it was exhaustively tested by the coincidence of all three signals when the observers were close to the lightship.

The results of the experiments are shown on the drawing. The loci of the observing vessel with respect to the lightship, as computed from the distance traveled by sound in water, between the time of the arrival of the Hertzian waves and the signals from the submarine bell signal fixed to the bottom of the lightship, are connected by dots and dashes, while the loci, as determined by the distance traveled by sound in air, between the times of arrival of the Hertzian waves and the signals from the steam fog whistle, are connected by dashes.

A remarkable feature of the tests was that the sounds from the steam fog-whistle were lost after steaming half a mile to the westward of the lightship, at the beginning of the experiments, but in the run to the eastward they were carried throughout the run. The wireless signals were carried all the way through, and the submarine bell signals were lost but four times.

The times of arrival of the wireless signals and the steam fog-whistle signals were recorded by means of a Hack chronometer, and the times of arrival of those from the submarine bell by a stop watch. The same observer noted both the wireless tick and the submarine-bell signal. For the velocity of sound in air at a temperature of 68½ deg. Fahr. a speed of 1,132 feet per second was used, and Dorsing's determination of the velocity of sound in water as 4,794 feet per second at 66 deg. Fahr. was adopted.

Interval of time between the receipt of the wireless and bell signals multiplied by the velocity of sound through the water will give the distance of the ship from the spot from which the signals are sent within three or four hundred feet.

For instance:

Time between wireless and bell	4 seconds
Velocity of sound in water	4,794 feet per second
Distance of ship from bell...	19,176 feet

Further tests are to be conducted by the Navy regarding the perfecting of the submarine signaling system. Foreign nations have done much more to develop this system of signaling than has the United States. It has been reported to the Department of Naval Intelligence that some of the big German ships can find their way into the harbor at Hamburg and up the river by means of the submarine bell and fog whistle checked up by the wireless.

The Competition for the New York, New Haven and Hartford Railroad Company's Automatic Stop

CHARLES S. MELLEN'S offer of $10,000 for the best automatic stopping and speed control device which would safely arrest trains disregarding fixed signals, expired on July 1st. On that date 2,816 persons in all had entered the competition. The applicants represent every country, including China, Japan, and Australia.

While a total of 2,816 persons have responded to the original offer and may be said to have entered the competition, only 704 of the applicants thus far have submitted plans in reply to the circular sent to each applicant giving the conditions and requirements of the competition. This does not eliminate the others because the conditions prescribe that to be acceptable a device must be adopted for general use by either the New Haven, the Pennsylvania or the New York Central roads "within the years 1913, 1914, or 1915." Consequently any inventor who got his name on the list of applicants on or before July 1st has the right of qualifying until January 1st, 1916.

The amount of labor involved in President Mellen's offer may be estimated from the fact that C. H. Morrison, chief signal engineer of the New Haven, who has been placed in charge of the competition, up to July 1st had written 4,062 letters, and 1,483 copies of patents had been obtained from the Patent Office.

One of the reasons underlying President Mellen's offer was the fact that at the present time there is no automatic stopping device in regular operation on any of the steam surface roads of this country, though some roads are conducting experimental tests. The New Haven road, however, is the only road which has thus far offered a reward to inventors for such a device. The stopping devices operated on some elevated and subway lines, notably in the New York subway, while effective on such lines, have not been designed to meet some of the conditions required by steam surface lines, one of these being the ability of the device to work under all weather conditions and to be impervious to either sleet or snow.

Inasmuch as the approval of the Interstate Commerce Commission would be necessary before the New Haven would feel justified in putting a stopping device in regular operation, the requirements laid down by the Train Control Board have been adopted as well as eight additional ones made necessary by the peculiar conditions of the New Haven lines.

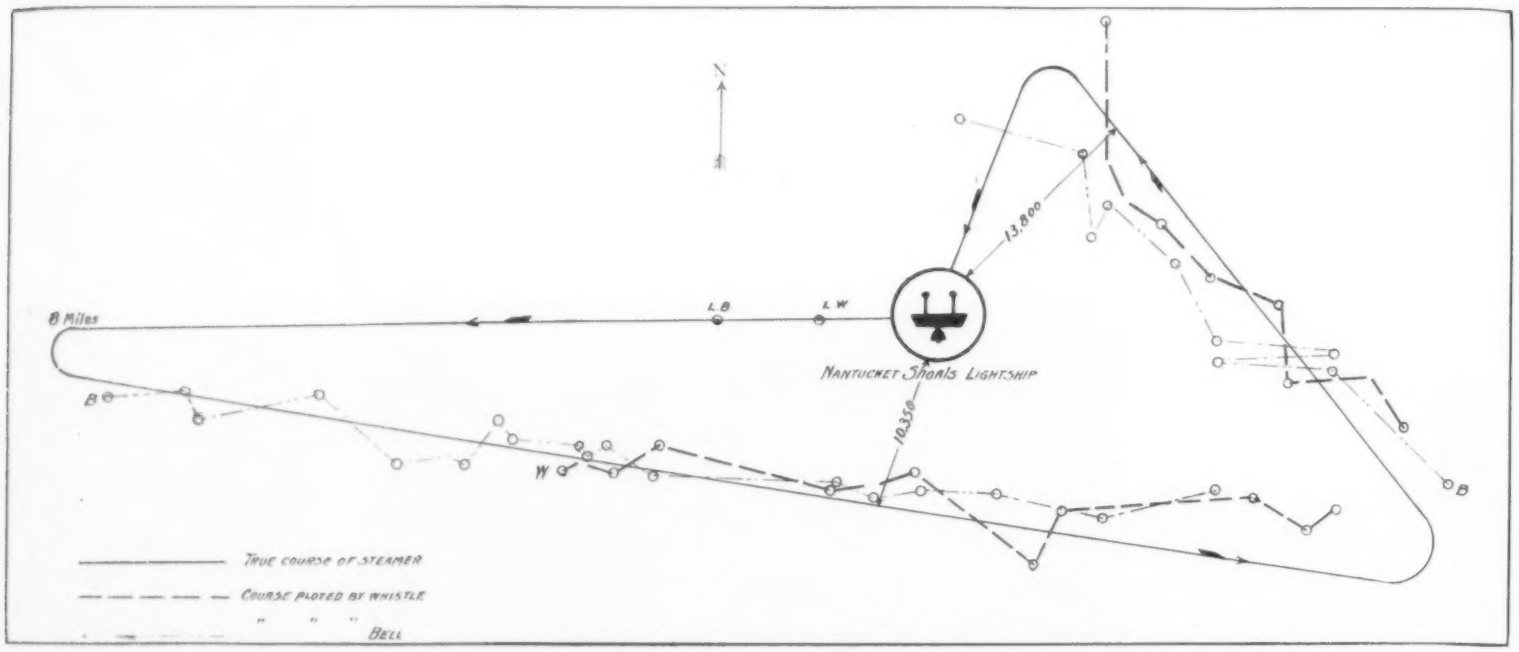
Of the 704 devices of which plans and models have been submitted thus far, it is announced that not one has met condition No. 1, which reads: "The apparatus should be so constructed that the removal or failure of any essential part would cause the display of a stop signal and the application of the train brakes, and if electric circuits are employed, they should be so designated that the occurrence of a break, cross, or ground, or a failure of the source of energy in any of the circuits, should cause the display of a stop signal and the application of the train brakes."

A few of the devices already submitted might be perfected, it is said, so as to meet this requirement, and no doubt this will be done. A very large percentage of the devices have failed to embody any speed control feature, also one of the conditions, this being a provision that a train at a speed less than a pre-determined number of miles per hour might pass the automatic stopping device without application of the brakes. Also many have failed to meet the requirement that the device should work under snow, ice, sleet or freezing conditions.

All sorts of ideas are represented in the models and plans now in possession of Engineer Morrison. Most of them show that the inventors, while intent on fulfilling some of the eighteen requirements specified in the circular, have totally disregarded others, particularly that one providing that the failure of the device to work, such as might be caused, for instance, by a person tampering with it, would of itself cause it to stop the train.

Despite the fact that not all of the requirements have been met, the railroad will proceed at once to test the more meritorious of the devices submitted. These tests will begin the middle of this month, and will take place on the western division between Hartford and Newington. The two automatic stop systems coming the nearest to all of the requirements will be tested first. One is the invention of Gene Webb, and is the property of the International Signal Company. The other is the invention of an engineer of the Union Switch and Signal Company. These will be tested out practically at the same time by the Lackawanna road. Both make use of an electric current picked up from a third rail. The tests of these and other systems submitted may take a year, as it is necessary to see how they meet all weather conditions. A locomotive will be equipped with each device and operated over the track selected and on which the stop has been installed.

Obviously no award can be made until the expiration of the year 1915, as until then every inventor who has entered the competition has a chance so to perfect his device as to make it acceptable. The reward, under the conditions announced, is to be paid on the order of the Interstate Commerce Commission, the Massachusetts Railroad Commission and the Connecticut Public Utilities Commission.



Actual course of the United States steamship "Washington" and course as plotted by fog horn and submarine bell.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Lifeboats Which Can Be Launched on Either Beam

To the Editor of the SCIENTIFIC AMERICAN:

With reference to the article appearing under the above heading in your interesting journal of June 7th last, allow me to correct the statement that the Flushing steamers are owned by the Netherland State Railways. These steamers are owned and operated by a separate corporation, namely, the Zeeland Steamship Company.

At the same time I would like to draw your attention to the fact that the devices by which lifeboats can be launched from either side of the vessel, has not only been installed on the night steamers of the Flushing line, as day steamers of this company, running between Queenboro and Flushing, have for a long time been similarly equipped. Another life-saving device has been introduced on the Flushing steamers, namely, an accumulator battery, situated near the wireless room far above the water level. In case the ship's dynamo should be stopped for any reason, its work is taken up *automatically* by this accumulator battery, which develops enough power to keep the wireless apparatus in operation for about eight hours after the dynamo stops.

New York city. C. BAKKER, General Agent.

The Inventor and Price Fixing

To the Editor of the SCIENTIFIC AMERICAN:

I have read with very much gratification the article on "Benefits of Our Patent System—the Difference Between Monopoly and Patent Protection," by Jesse B. Fay of Cleveland. It seems to me that no one could read this article without getting a very clear idea of the difference between the illegal monopoly and the monopoly granted by the patent system. The article excellently supplements the vindication of the patent monopoly set out in the minority report accompanying the Oldfield bill.

Referring to the recent decision of the Supreme Court of the United States declaring that the patentee has no right to control the price of the patented article after the ownership has passed from him, it occurs to me that there is a misconception as to what actually takes place in the sale of the patented article where the patentee fixes the final selling price. In such case, the seller retaining the right to fix the price, as has been done in safety razors and other things, it is clear to my mind that the patentee or seller has not parted with his complete title in the article. He retains enough of title in the vended articles to entitle him to say at what price the articles shall be sold.

The transaction is very much akin to conditional sales, well recognized in common law, where the vendor retains title in the articles of merchandise until he has fully received his pay, and yet for all practical purposes, so far as the vendee or merchant is concerned, he has bought the goods outright, subject, of course, to this remnant of title left to the vendor. If the owner of a patent retains the right to fix the selling price, he is, in a similar manner, retaining a portion of his title that would legally give him the right to dictate the selling price.

Unless the patentee is able to control the price at which his goods shall be sold, the value of his monopoly is gone, a fact that has been abundantly proven in the history of many patented articles getting into the hands of price cutters, as department stores and the like. This phase of the case, however, has been so abundantly manifested by much previous discussion that it is not necessary for me to suggest anything further.

If the recent decision is final, it seems to me it is worth while for those interested in patent matters to work for restoration of the right of the patentee to fix the final selling price. C. W. DICKINSON.

La Crosse, Wis.

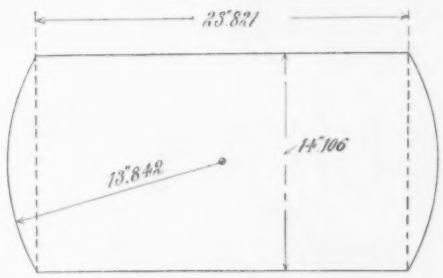
The Maximum Parcel

To the Editor of the SCIENTIFIC AMERICAN:

In your number of May 17th, 1913, Mr. Joseph Becker has an interesting communication on the maximum parcel that can be accepted for transportation under the present Parcels Post regulations, which prescribe that the sum of the girth and length must not exceed 72 inches. Very likely Mr. Becker's interpretation of the regulations agrees with that of the Post Office Department, but I venture to point out that it is not consistent with the wording of the regulations, which say "in measuring length the greatest distance in a straight line between the two ends of the parcel shall be taken." If we have a rectangular package and take as its length the perpendicular distance between the planes of the ends, we are using for the length not the "greatest" distance in a straight line between two ends, but the "least" distance between the two ends. The greatest distance in a straight line between the two ends of a rectangular package is obviously the diagonal of the solid.

In this case the largest rectangular package that can be accepted under the literal wording of the Parcels Post regulations is, using dimensions to three decimal places, 10.286 inches square and 27.214 inches long on an edge; the diagonal being 30.857 inches. Such a package will contain 2,879 cubic inches only.

The very largest volume that can be accepted for Parcels Post transmission under the regulations will be a cylinder with spherical ends, as indicated in the inclosed sketch which gives an axial section of the solid. The diameter of the cylinder will be, to the third decimal place, 14.106 inches, and the length of the side, to the third decimal place, will



The maximum parcel.

be 23.821 inches, the cubical contents being 4,032.19 inches.

The problem of the maximum volume was recently printed as a puzzle in a New York newspaper, and a right cylinder with plain ends was given as a solution. This solution was open to the same objection pointed out above, namely, that for such a figure the length was not the greatest distance in a straight line between the two ends, but the least distance in a straight line between the two ends. D. W. TAYLOR,

Washington, D. C. Naval Constructor, U.S.N.

Grant Linton Replies to Mr. Hanna

To the Editor of the SCIENTIFIC AMERICAN:

Your ssue of date May 10th is at hand, containing your correspondent's criticism of my plan of aeroplane supporting surface design discussed in my letter of March 10th.

Mr. Hanna claims that the sustaining force of the wire or cord constitutes of itself an element in the equilibrium of the forces. This is indeed true; for, besides the one system of forces, namely, weight balanced by the vertical component of the air pressure or lift, there is the horizontal component of the air pressure or drift balanced by the sustaining cord, which latter system the writer omitted to mention in order to avoid complexing the problem. Mr. Hanna has confused these two distinct and entirely separate sets of forces. Thus, the only appreciative effect the sustaining cord could possibly exert upon the vertical system is that caused by its own weight, which of course would be negligible.

Mr. Hanna challenges my assertion that the air is flowing horizontally at the forward edge of the fabric. Is it necessary to mention that when the writer used the term horizontal he did so only to indicate the general direction of the line of flow of the air stream? Whether the direction of flow were horizontal or slightly divergent from the horizontal could not have a detrimental effect upon the proper working of the fabric.

Again, Mr. Hanna avers that at greater angles of incidence than 30 degrees there will be a decrease in the absolute lift of the air pressure, but an increase in the absolute drift, instead of a proportionate decrease in each case. Now we have Mr. Hanna's word for it farther down in his letter that "5 degrees is about the maximum (angle of incidence) now found in efficient aeroplanes," so that this fact then precludes the possibility of the exception cited having any effect upon the feasibility of the plan proposed.

Mr. Hanna's confessed ignorance of the truth of my statement that "in both classes of vehicles the best efficiency could only be obtained by altering the length of the cord," is hard to reconcile with his own declaration that "the late A. Cary Smith, by means of a contrivance called the reach reef, which enabled the curvature of a sail to be varied manually at will, succeeded in substantially increasing the speed of a number of racing yachts." Evidently Mr. Hanna is unaware of the fact that exquisiteness of detail is just as an important matter, and more so in the design of the aeroplane than in the design of the sailing yacht, or that refinement of existing models constitutes of itself the chief hope of the student of the heavier-than-air machine.

As an answer to Mr. Hanna's contradiction of my statement that "full speed when once attained is as regular as that of the highest types of machinery," the writer would cite as a particular instance the performance of Vedrines, the winner of the last contest for the Gordon-Bennett Aviation Trophy, at Clearing, Ill., September 9th, commenting upon which Major Samuel Reber says: "The speed at which he (Vedrines) made his fastest lap was 106.3 miles per hour, and that at which he made his slowest was 103.2 miles per hour; . . . the maximum percentage variation in speed made in any lap from his average speed was 1.8 per cent, or in other words, a speed regulation obtained only in the highest types of automatic machinery." As for the reference to reports of tests made on a Zodiac biplane, let the writer inform Mr. Hanna that the biplane is by no means acknowledged the most highly specialized type of the heavier-than-air machine; also that though "the ability to vary the speed of horizontal flight within wide limits is a most desirable quality of the aeroplane," this feature (as attained at present) is only a proof of poor design, or at least of inefficient running.

As an authority for "the belief in the parabola as the only correct basic curve for wing sections," which Mr. Hanna takes exception to next, the writer could quote no other than the Montgomery, whom Mr. Hanna mentions so often in his letter. How Mr. Hanna could have put any other construction upon my meaning than one identical with the belief held by the gentleman himself is a mystery to the present writer. Not to further intrude upon valuable space in what would be mere reiteration, therefore, the reader is referred to the last paragraph of the letter in which the plan was originally proposed, where he will find the final answer to Mr. Hanna.

When Mr. Hanna says, "I have often observed a piece of fabric suspended by one edge in a current of air, and I never saw one piece rise to a sufficiently acute angle of incidence for aeroplane use without beginning to flap or undulate," he shows clearly that he has failed to grasp even the fundamental principle of the plan, for the undulating of the fabric mentioned by him obviously could occur only when the speed of the air is such that the pressure exerted by it upon the fabric is vastly greater than the weight of the fabric itself. This condition is commonly seen when a piece of flexible fabric (necessarily very light unless loaded) is suspended in a wind of even moderate velocity; and it is quite clear, from his own description, that this is the condition Mr. Hanna had in mind when he made the statement quoted above. Then again Mr. Hanna falls into a very grave error in assuming that, because the upward component of the air pressure is uniformly distributed over the surface, the total air pressure is likewise. Here he fails to take into consideration the effect of the horizontal or drift component of the pressure.

In making a distinction between the two surfaces of the wing, Mr. Hanna has introduced an entirely new particular, which for simplicity was omitted by the writer. The "single" surface is, of course, a compromise between the two possible best efficiencies of upper and lower surfaces; but, in consideration of the fact that, despite its undoubted inefficiency, many aeroplanes use this type of wing, the writer felt himself well within his rights in limiting an explanation of the application of the plan to this type alone. However, if Mr. Hanna really desires an answer to his query, the writer would suggest subjecting the upper and lower surfaces singly to the air flow, and then comparing the forms thus obtained (as regards angle of incidence, etc.) for an adjustment of relative loadings, and then joining the two together in the construction of a rigid plane. This system would have the added advantage of eliminating the modifying influence of the bars of metal objected to by Mr. Hanna, for these of course could be attached on the side of the fabric opposite that being subjected to the action of the air stream.

Mr. Hanna has failed to point out in his letter why an analogy between the action of the sail and the proposed plan of aeroplane supporting surface design cannot be admitted. The reason for this, as well as the reason for the failure of the Vlaicu monoplane which employed wings of flexible fabric is, as was very kindly suggested to me by Mr. Guy Lowell of Boston, that, whereas we obviously are limited in a *direct* application of the plan to one point of suspension of the fabric, in the monoplane experimented with there were necessarily two, and in the yacht sail there are at least three.

GRANT LINTON.

Bowmanville, Ontario, Canada.

A Machine for Blowing Window Glass

The Remarkable Sievert Process

IN the usual method of blowing window glass the workman takes up a globular mass of semi-liquid glass with the end of a long iron tube and, by blowing through the tube and reheating the glass at intervals, gradually transforms the ball into a long, hollow, thin-walled cylinder. When this cylinder has cooled, its ends are cut off, and it is slit lengthwise and flattened into a plane sheet of glass by heating and mechanical treatment.

In the Sievert process of blowing window glass by machine, which has been employed successfully in several European factories, a disk or cake of glass is first made by pouring molten glass into an iron ring *b* (Fig. 2, an insert in Fig. 1), resting on an iron casting plate *a*. A blowing-head *c* connected with an air pipe *s* is then brought down on the ring and attached to it. When the glass has cooled sufficiently the blowing-head and ring are lifted from the casting plate, carrying with them the cake of glass, which, being in plastic condition, sags through the ring and assumes the form of a cup, which is then blown into cylindrical form by compressed air introduced through the pipe *s*. The Sievert process, which can be employed for blowing hollow glass vessels of all kinds, possesses the following peculiar advantages:

1. The glass "head" of the cylinder or vessel is replaced by the metal blowing-head *c*, diminishing the quantity of glass wasted or re-melted.

2. As this blowing-head may be of any diameter, it is possible to blow cylinders and vessels of extraordinary size.

3. Several shallow vessels or flat objects can be blown at once with little waste of glass by blowing the cake of glass into a mold having a number of cavities.

4. The time and skill required for the tedious operation of forming the ball of plastic glass by working the molten glass with the blowing tube are saved, as a cake of uniform temperature and consistency is obtained simply by pouring the molten glass into a ring laid in a casting plate.

5. In the form of a cake of large area and comparatively small thickness a very large quantity of glass can be blown at one operation, without wasting much time in cooling the glass to the proper consistency.

Hence the process is most suitable for the production of flat objects, wide-mouthed vessels and very large objects generally, and especially of cylinders destined to be transformed into sheet glass.

For these diverse uses the process and apparatus have assumed various forms. An ingenious and elegant method of producing very large shallow vessels has been devised. The molten glass is poured on a moist asbestos felt which is briskly shaken. The glass dances upon the layer of steam evolved by its own heat and spreads out into a round cake of small and uniform thickness which is blown by the pressure of the imprisoned steam into the inverted mold which is brought down upon it. The Dresden inventors have recently patented an arrangement in which the asbestos mat is mounted on an axis, about which it is oscillated by an electro-magnetic device.

The Sievert process was first employed for the production of very large glass vessels, such as bath tubs and fermenting vats. For this purpose an apparatus resembling that shown in Fig. 1 is used, but the glass is poured, not on a special casting plate, but on the blowing-head itself, which is inverted. When the glass has cooled sufficiently the apparatus is re-inverted and the glass cake, sagging through the ring, is blown downward into the mold. In this case the ring, which is very large, is made in several parts, which are separated in order to release the vessel.

In order to adapt the process to the blowing of cylinders for window glass, several important changes were required. A bath tub is broad and shallow, but a window glass cylinder is long and comparatively narrow. Hence it was necessary, in order to distribute the glass uniformly over the whole length of the cylinder, to place beneath the machine a deep heating drum of peculiar construction by which either the whole cylinder or any part of it, especially its upper edge, could be reheated at any time. It was also necessary to devise a safe and rapid method of attaching the blowing-head to, and detaching it from the ring which carries the glass cake or cylinder, by a mechanism capable of withstanding frequent and intense heating. This problem has been solved brilliantly by placing in the rim of the blowing-head a circular

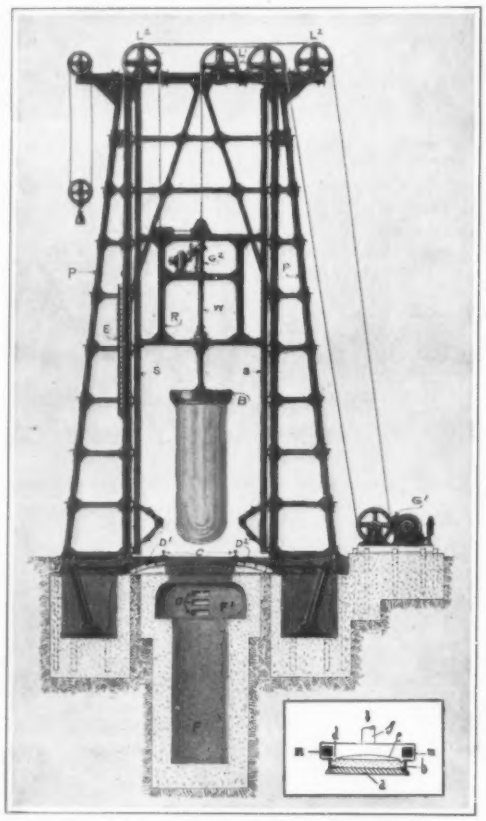


Fig. 1 and Fig. 2 (insert).—Sievert's window glass blowing machine.

electro-magnet *m m* (Fig. 2), which holds the ring securely while the current is flowing and releases it instantly when the circuit is broken.

Two experimental machines for blowing window glass were tried, one in France, the other in Austria. The experience acquired with these machines was utilized in the construction of a third machine, which was put into operation in Saxony in October, 1909. This machine is illustrated in Fig. 1. A fixed frame of girders *P*, about 30 feet high, supports two vertical guide-rails *S*, along which the frame *R* can slide up and down. The sliding frame *R* carries the blowing-head *B*, and is raised and lowered by means of a steel wire rope, which runs over the pulleys L^1 and around the electrically driven winch G^1. Little force is required to move the sliding frame, because its weight is balanced by a counterpoise *E*, attached to a second wire rope that runs over the pulleys L^2 and around the winch G^1 in a direction opposite to that of the first rope. Safety clutches prevent the fall of the frame with its load of glass in case of rupture of the rope. The blowing-head *B* is attached to the lower end of a hollow vertical axis *W*, the upper end of which is connected, through a stuffing-box, to a compressed air conduit. This axis can be rotated by the motor G^2, mounted in the sliding-frame. The glass cylinder suspended from the blowing-head can thus be turned slowly without interrupting the blast of compressed air. Under the blowing-head and imbedded in the ground is the deep heating drum *F*, with its wider and dome-like top F^1. The lower part of the drum is not heated, but the dome contains a ring of gas-burners *O*, by means of which any zone of the rotating glass cylinder can be heated at will by lowering the cylinder more or less deeply into the drum. The top of the heating drum can be closed by sliding over it the cover plates D^1 D^2, which are moved by a third electric motor. By means of a fourth electric motor a car carrying a wooden bed-plate and traveling on the rails *C* can quickly be brought under the glass cylinder to support its lower end, if necessary. The cast cake of glass is brought beneath the blowing-head by a second car, which travels on the same rails. The starting levers of the four electric motors, the lever which makes and breaks the circuit of the electro-magnet on the blowing-head and the tap for the compressed air are placed together in an operating stand beside the main frame of the machine, so that one man can easily control and regulate every operation. This arrangement gives the process a great advantage over all entirely automatic methods of producing window glass.

The manner in which the cake of glass is fastened to the carrying ring and the blowing-head is shown in Fig. 2. The ring *b* is Z-shaped in section, and the blowing-head *c* carries a circular rabbet *d*, which projects downward. When the blowing-head is lowered upon the ring filled with glass the magnet *m m* takes firm hold of the upper or exterior flange of the ring, while the edge of the soft cake of glass is pinched tightly between the rabbet *d* and the vertical web of the ring, and also between the rabbet and the lower or interior flange of the ring. When the blowing-head is raised, therefore, it carries the ring and the sagging cake of glass up with it.

The whole operation of blowing a window glass cylinder with the machine is conducted as follows:

The car, bearing the casting plate and carrying ring, is wheeled to the furnace, and the ring is filled with molten glass by means of a ladle, or otherwise. The car is then wheeled to the blowing machine, which is provided with guides and stops that bring the center of the ring accurately under the center of the blowing-head. The blowing-head is now lowered on the ring and then raised, carrying with it the ring and the cake of glass. Next, the car is removed, the cover plates of the heating drum are drawn aside and the cake of glass, which has now sagged into the form of a bowl, is lowered into the drum and reheated, while it is rotated slowly by turning the blowing-head. When the glass has softened sufficiently it is hoisted out of the heating drum and blown into the form of a cylinder by turning on the compressed air. The reheating operation is repeated, if necessary. If the cylinder extends too rapidly the auxiliary car is quickly wheeled under it to support its lower end. When the cylinder has attained the desired length a removing fork, suspended from a carriage sliding on overhead rails, is brought under the edge of the carrying ring, which is released from the blowing head by breaking the circuit of the electro-magnet. The glass cylinder, thus suspended from the traveling fork, is carried away and deposited in a frame, which is subsequently tilted over so that th cylinder rests, in a horizontal position, on supports covered with asbestos. By means of a clamp, which can be moved along a rail extending above the row of frames, the carrying ring is seized and supported while the upper end of the cylinder, attached to the ring, is cut off by applying a hot thread of glass. By the same method the lower end of the cylinder is cut off, and the cylinder is split lengthwise into two

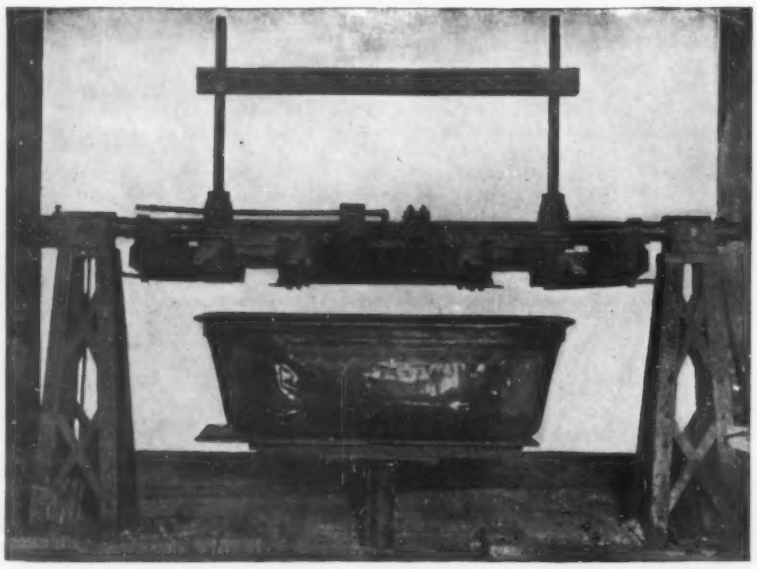


Fig. 3.—First Sievert machine for blowing large glass vessels.

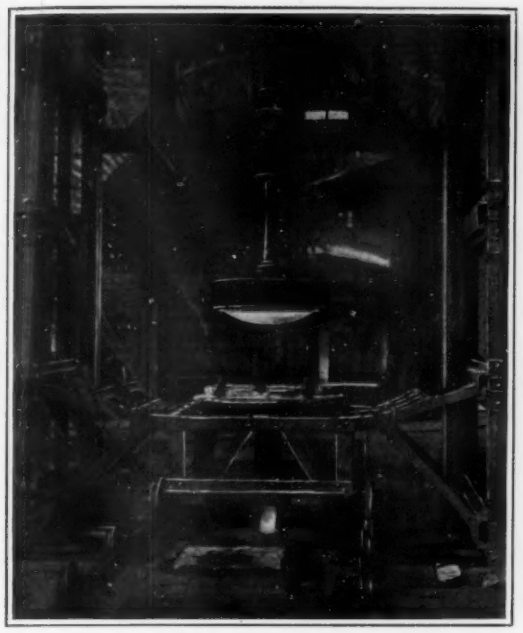


Fig. 4.—The cake of glass, sagging from the blowing-head, which has just lifted it from the car.

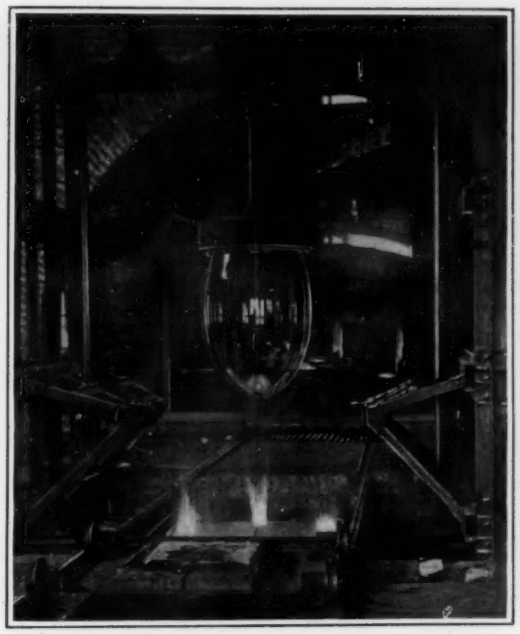


Fig. 5.—The car removed and the cake sagged into the shape of a bowl.

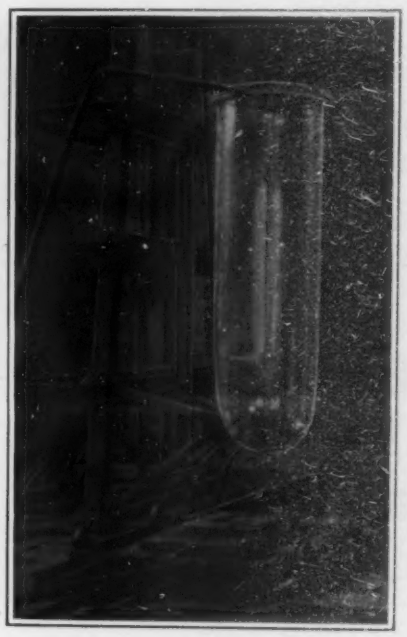


Fig. 6.—The finished cylinder suspended from the removing fork.

or three segments, according to its diameter. These cylindrical segments, like the hand-made cylinders, are transformed into plane sheets of glass in the flattening oven.

The capacity and efficiency of this machine were satisfactorily demonstrated by its performance during its first half year of practical service. The production of sheet glass per working hour increased from 25 square meters at the beginning of this period to 37 square meters at its close, and has since risen to 40 square meters. A carrying ring 65 centimeters (26 inches) in diameter, yielding cylinders of the same diameter, was used, and the thickness of the glass was 2.5 millimeters (0.1 inch). The remarkable increase in production is attributable to increase in skill, particularly in the avoidance of breakage. At the end of the period it often happened that not one of the 110 to 115 cylinders made in a shift of 7½ hours was broken. This result is largely due to the uniformity in thickness produced by the construction of the heating drum. The hourly output can be increased by using larger rings and by substituting for the ladle a mechanical filling system which will keep several rings, casting-plates and cars in operation, thus saving the time (about one minute) now wasted in waiting for the cake to cool. The actual blowing of a cylinder occupies only two or three minutes.

The glass is of remarkably good quality, uniform in thickness, free from air bubbles and with a very even and glossy surface. These results are due to the uniform temperature and thickness of the cake of glass, its symmetrical position with respect to the air tube and the employment of a vertical heating drum. In the common method the ball of glass is made up of portions taken up successively by the blowing-tube and is, therefore, likely to be neither symmetrical in shape nor uniform in temperature. The hand-made cylinder, furthermore, is reheated in a horizontal position, and is consequently liable to deformation, and also to scratches, which are entirely excluded when the vertical cylinder is mechanically lowered into the heating drum without touching the latter.

The new method of flattening also improves the product. The wide machine-made cylinder is split into two or three longitudinal segments which flatten almost automatically on the hot flattening stone. Hence they are exposed to little risk of injury from the iron flattening rod, the treatment with the polishing block is shortened, the capacity of the flattening oven is increased, and a more even and glossy surface is obtained.

More glass is wasted (i. e., returned to the melting pot) in the new process than in the old one, but this loss is more than compensated by the saving in wages and other operating expenses. The new process requires comparatively few workmen, who need not be skilled glass-blowers.

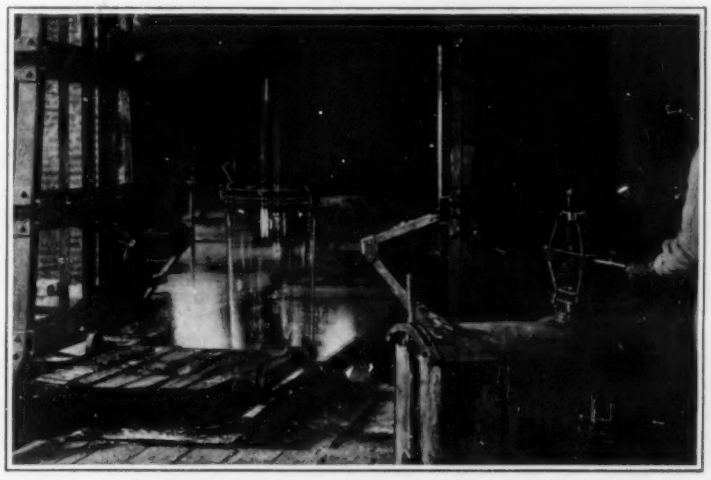


Fig. 7.—The glass bowl lowered into the heating drum.

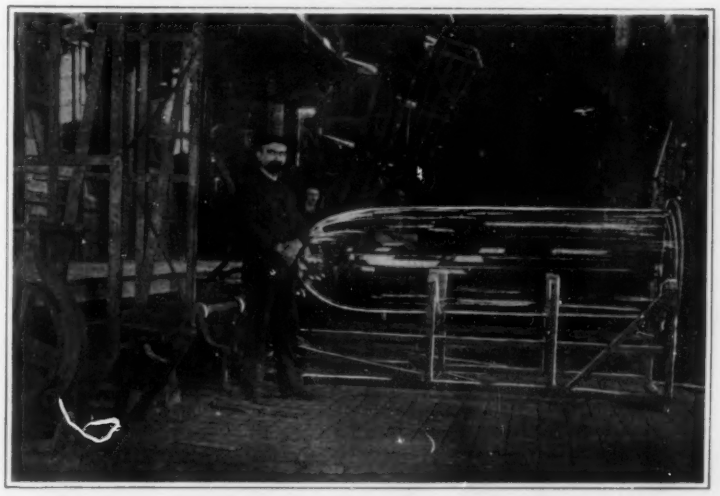


Fig. 8.—Cylinder in the tilting frame.

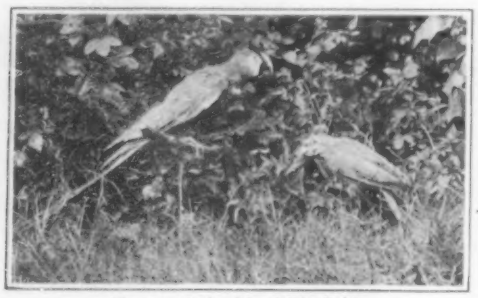
Fig. 9.—Glass segments stacked beside the flattening oven.

From the results obtained in the six months' trial of the machine in Saxony it has been calculated that the cost of producing one square meter of glass, cut and packed for shipment, is more than 18 per cent less with the new process than with the old one. Another calculation, made independently by a Belgian expert, and based on Belgian working conditions, yields nearly the same result. Experience and the introduction of improvements, some of which have been mentioned above, may be expected to increase the output and diminish the cost of production still further.

The Sievert machine can be employed in the production of crackled, marbled and other varieties of sheet glass, in addition to common window glass, and it finds another important field in the production of glass bath tubs, kneading troughs, milk troughs, wash tubs, acid tanks and other large vessels. The operation is conducted substantially in the manner described above for window glass cylinders, except that the glass is blown into a mold, if necessary, and the finished vessel is sent to an annealing oven instead of to a flattening oven. The production of large glass vessels by means of a tilting blowing-head into which the glass was poured has already been mentioned, but the improved machine represented in Fig. 3 offers several advantages. The liability to breakage and uneven thickness and tension due to the tilting of the mass of soft glass is avoided, and the uniformity and gloss of the vessel can be improved by repeated dipping into the heating drum, while the electro-magnetic suspension facilitates the entire operation. Glass vessels reinforced by wire netting have been made with the old machine and a still more intimate connection between the glass and the netting can be obtained with the improved machine and process.

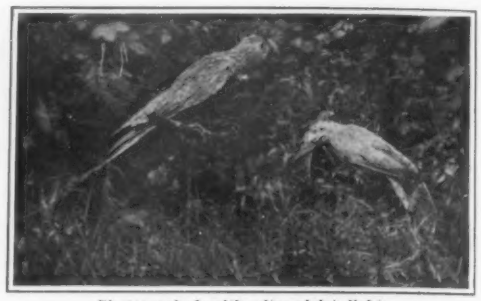
No glass is wasted in blowing vessels by this process as the thick rim that forms about the carrying ring is left on the finished vessel and increases its strength.

The contour of the ring and blowing-head must conform to the outline of the rim of the vessel, but vessels of different depths can be blown with the same ring and blowing-head, and the diameter of the vessel can be varied somewhat by using, with the same blowing-head, carrying rings with vertical inward-slanting or outward-slanting webs.



Photographed with visible light.

Photographed with infra-red light.



Photographed with ultra-violet light.

Ara militaris, Chrysotis auripalliata and Conurus petzii photographed by visible and invisible light.

Do Animals See Things as We Do?

By J. Fidel Tristan, Costa Rica State College

ALL the colors of the rainbow can be observed on the plumage of birds. Pure white and intense black are common; the most extraordinary shades are seen among the tropical humming birds (*Trochilidae*), some of them showing a metallic luster in many colors. The same can be said of diurnal butterflies, of coleopters and of larvæ.

Naturalists generally try to explain this variety of colors through the intervention of natural selection and mimicry. When such an explanation is offered it is invariably assumed that animals see things as we do. The writer believes that many serious difficulties which are frequently met with while making such hypotheses would subside if the assumption—unwarranted by facts—that all eyes, throughout the animal kingdom, are adapted to one and the same scale of ether undulations was prudently left aside.

The many ways of living observed in animals, the imperious necessity of clearly seeing, in very different circumstances, either the game or the hunter, are so many factors which may cause the sight of animals to differ from ours. It is well known, for instance, that some birds can see small objects from a distance which causes them to be, for us, lost in a haze, created by the atmospheric diffusion of the blue and of the violet. Other birds, mammals, and insects begin their quest for food after sunset, when light contains a high percentage of extreme red and infra-red rays, which hardly make any impression upon our retina. In the tropical forest, a simple oil lamp will fetch an incredible number of butterflies and other insects, the existence of which could not even be suspected during the day. These facts and many others seem to show that the eyes of some animals are probably more sensitive than ours to one or the other extreme of the spectrum, and that the relative luminous value of colors may not be for such animals what it is for us. The results of the following experiments, recently made by the writer, seem to him of such a nature as to lend additional force to this hypothesis: the following stuffed species were placed in a mass of green foliage: *Ara militaris*, *Chysotis auripalliata*, and *Conurus petzii*, two of them being partially or totally of such a green color as to be easily mistaken, at a distance, for a part of the foliage. Three photographs were taken of the whole: one in visible light, one in ultra-violet light and one in infra-red light, the last two by means of Foucault's silver film and quartz lens and of Prof. Wood's cobalt glass and yellow film. On the photograph made in the infra-red light, the green plumage and fur, which do not reflect the infra-red, come out as dark spots over the clear field of the foliage, which strongly reflects the infra-red. Here we have two kinds of green, which look alike to the human eye and which would appear as entirely different to an eye which would be somewhat more sensitive than ours to the extreme red.

Another group photographed in the same manner is also reproduced, and the numerous differences, seen at a glance, give an idea of how things would appear to any eye for which the scale of perceptible vibrations would have been either raised or lowered by even a few Angstrom units.

The Longest Aeroplane Flight

BRINDEJONC DES MOULINAIS, the French airman, landed at 4:20 o'clock on July 2nd at the Villacoublay aerodrome, near Versailles, thus terminating his wonderful flight of about 3,000 miles from Paris to St. Petersburg and back and establishing a record for the longest aerial voyage so far accomplished.

The following is a diary of the flight: June 1, Paris to Warsaw, 933 miles; June 15, Warsaw to Dvinsk, 330 miles; June 16, Dvinsk to St. Petersburg, 310 miles; June 23, St. Petersburg to Reval, 200 miles; June 25, Reval to Stockholm, 250 miles; June 29, Stockholm to Copenhagen, 330 miles; July 1, Copenhagen to The Hague, 385 miles; July 2, The Hague to Paris, 240 miles.

M. des Moulinais was escorted on the last stage of his great flight by French airmen.

Results of the Prince Henry Aeroplane Circuit Race in Germany

FOR the third time there was held (in May last) in Germany a circuit race by German aeroplanes for the Prince Henry cup. This race lasted three days, and was flown over a triangular circuit. The course was from Wiesbaden to Cassel, from Cassel to Coblenz, and from Coblenz to Karlsruhe, a total distance of 354 miles. Nineteen machines started in the contest, of which seventeen finished the first stage, four not arriving until the second day. Ten military aeroplanes and three civil pilots made perfect flights. The flight the first day was made under good weather conditions, but the second day's flight was a difficult one, as a range of mountains had to be crossed and the weather was bad. Only ten machines completed this stage. The third day's flight was made under excellent weather conditions. Four military and five civil pilots completed this stage, out of the eleven military and five civil pilots that started in the circuit. Following the circuit, two days of scouting were held by military machines only, in which twenty-three pilots started. The trip to Strassburg was made with a stop at Pforzheim. Nineteen aviators landed and re-ascended at the latter place and seventeen arrived at Strassburg. Twelve left the next morning for the final flight to Freiberg and Neubreisach, where landings and reports were to be made, and of these nine returned to the starting point. The reconnoitering reports made while in flight were handed in at the various landing places and new tests were set for the aviators. These scouting flights in reality saved the event as far as the military aviators were concerned, for in the three days of cross-country flying many of the army aeroplanes suffered motor breakdowns. In awarding the cups, at the conclusion of the circuit, Prince Henry called attention to the lack of reliability shown in the motors.

Lieut. Canter on his 57 horse-power Rumpler "Taube" monoplane, won the Emperor's cup for the best performance throughout the circuit, and also the second cash prize for reliability, as well as the Prince Henry prize for the best performance in the military scouting competition. Other important prizes were won by Engineer Schlegel on a 100 horse-power Avaitik monoplane, by Lieut. Joly on a 95 horse-power Gotha monoplane, by Lieut. Carganico on a 100 horse-power L. V. G. biplane, and by Lieut. von Beaulieu on a 95 horse-power Albatros biplane.

The First International Moving Picture Show

GRAND CENTRAL PALACE in New York city was last week the center of the moving picture world. More than three thousand delegates from all parts of the United States and Europe were in attendance at the third annual convention of the Motion Picture Exhibitors' League of America, which, in conjunction with the First International Exposition of the Motion Picture Art, opened on July 7th and lasted until July 12th.

Visitors at the exhibit saw how films are made from the raw material; how the lenses and projectors are developed from rough glass and metals to the finished product; how the pictures are taken, and last, but not least, how the completed film is thrown on the screen for the benefit of a public which has ceased to wonder at this recent product of science. On the mezzanine floor there were four model picture theaters, to which admission was free.

One of the principal attractions proved to be a moving picture shooting gallery. Here for hours the visitor could safely fight photographic battles with fierce African zulus and the sportsman could shoot at ducks or rabbits flitting on the screen for all the world as if in real life. This apparatus is fully discussed on another page in this issue.

Kinemacolor pictures played an important part in the exhibit. Not only were the machines demonstrated at a booth on the main floor, but moving pictures in the original natural colors of the subjects were shown in the kinemacolor theater. In this theater exhibitions of the natural color process were given at hourly intervals. It will be readily realized that such an apparatus as this, adaptable to a diversified list of subjects, is bound to prove of great benefit to science.

Although moving pictures in colors were introduced something over a year ago a great many improvements have been made recently, especially in the color screen through which the light from the projector passes before striking the film. The latest type of kinemacolor machine has a new revolving color screen which permits of adjustment in order to synchronize the screen with the moving film.

Color Blindness in Astronomers.—Dr. Edward C. Pickering, Director of the Harvard College Observatory, has tested the sensitiveness of the eye to various rays of different colors for numerous astronomers by grouping their estimates of the light of the stars according to their color, as shown by the class of spectrum. The earliest estimates, those of Ptolemy and Sufi, show results agreeing closely with those of recent times. Pierce shows a marked sensitiveness to the red, and Seidl to the blue rays. The latter effect is still more marked in photographic plates. All are referred to the Harvard standard, shown by the horizontal lines.

Photographed with visible light.

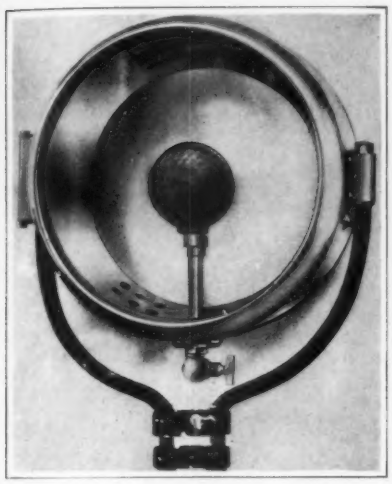
Photographed with infra-red light.

Photographed with ultra-violet light.

A group of stuffed birds of different species photographed with visible and invisible light.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks



Searchlight with auxiliary reflector in full-light position.

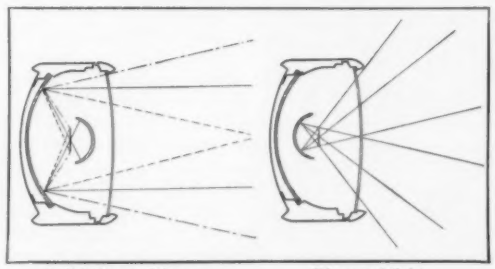
Highway brightly illuminated to a considerable distance by a pair of double-reflector searchlights.

Bridge approach lighted by two double-reflector searchlights.

Double-reflector Searchlight for Automobiles

By F. C. Perkins

PICTURED in the accompanying illustration is a new searchlight of German manufacture which is provided with a principal reflector and an auxiliary reflector. The principal reflector is a spheroid glass mirror, silvered on the reverse side and having an exceptionally large aperture ratio, the diameter of the free aperture and the focal length being respectively 10 and 3½ inches in the larger size and 8 and 2¾ inches in the smaller size. It will thus be seen that in view of the short distance of the flame or light source from the mirror, the latter gathers up a very large volume of light. The partly diagrammatic sectional view of the searchlight shows the auxiliary reflector first in its full light position in front of the light source and then in the subdued light position cutting off the light rays from the main reflector. It will be observed that in the latter position there is wide dispersion of the rays of light, whereas in the other position, not only is the light reflected from the principal reflector in the usual way, but it is also supplemented by the small auxiliary reflector. Only a small proportion of the light proceeding from the principal reflector is intercepted by the auxiliary reflector and this is made good several times over by its effect as an intensifier. On country roads the auxiliary reflector is turned to the full light position. When motoring through towns where gasoline searchlights are prohibited, the auxiliary reflector is turned through an angle of 180 degrees to the subdued light position, when the rays will be dispersed to such an extent as to give a general illumination. As the auxiliary reflector is exposed to an intense heat, because of its nearness to the source of light, it is made of a special glass capable of resisting the effects of high temperature and abrupt changes. The front glass of the searchlight is made of the same material, which does away with the necessity of building it up of several strips. This naturally affords a far better protection from dust and dirt than a cover made up of strips.



Full-light position. Dispersed-light.

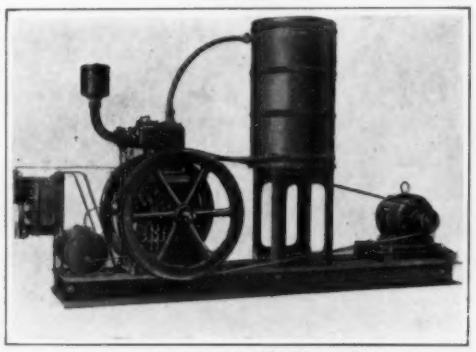
Automobile searchlight with reversible auxiliary reflector.

An Automatic Electric Light Plant

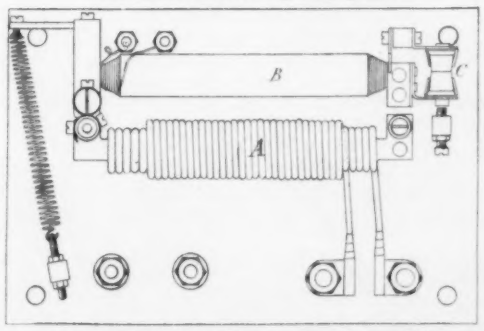
By F. C. Coleman

NOTWITHSTANDING the large number of electric generating stations that have been put into operation during recent years, there are still many places devoid of a public supply of electricity. Numerous small plants have been constructed for lighting private houses, etc., situated in such localities, particularly since the advent of the internal combustion engine. An interesting generating set of this description is manufactured in England, which starts and stops quite automatically, according to the load and condition of the storage battery. A plant of this type may be shut up in a room, where it will work without the slightest attention beyond filling of the gasoline tank and occasionally adding a little circulating water.

The engine is of the four-cycle type. Its cylinder is water-jacketed and the top end is fitted with a removable cover. The valves, which are well cooled, are of nickel steel and are placed in a side pocket. The carbureter is of the constant level type and is supplied by a small feed pump. It is claimed that it is impossible for the carbureter to be flooded. Since the engine is intended to work without attention, it is evident that the system of lubrication must be perfectly reliable and that oil must be supplied to the bearings as soon as the plant starts itself. To meet these conditions a force pump is provided. As soon as the engine commences to rotate, oil is pumped into the main bearings. It is afterward returned to the crank-case where a constant level of oil is maintained. Engines of this type are built for all classes of service, and capable of working with gasoline or kerosene, or by using a special valve, town gas can be used instead of liquid fuel. The whole of the plant, including engine, dynamo, controller, or automatic starting switch, and water tank, is mounted on two cross girders. Therefore the plant can be picked up bodily and transferred to any new position with ease.



Automatic electric lighting plant.



Relay switch providing automatic control.

Compact mounting of the lighting plant.

The complete plant comprises the engine, dynamo, and a small battery, the capacity of the last being very much below that of an ordinary private electric lighting plant. When the battery is properly charged and no lights are connected to the circuit the engine remains at rest. On switching on a number of lamps so that the current does not exceed the normal discharge capacity of the battery, the engine may still remain stationary until the voltage of the battery drops to a certain value. The engine then starts automatically and charges the battery. It will also start if the load exceeds the normal discharge rate. When the battery is charged and the load is low enough to be dealt with by the battery alone, the engine stops running. Hence the battery cannot suffer owing to improper handling. The battery is charged at the times it needs charging, and the charge stops when the correct voltage per cell is reached. There is not the least doubt that a great deal of harm is done to the batteries of private plants by overcharging them, and automatic control should prove a great boon in this respect. Even if the automatic gear got out of order and the battery was damaged in consequence, it is to be remembered that the cells are small and can be renewed at comparatively little cost. We are told, however, that the control gear never does get out of order.

Turning now to the principle of operation, let us assume that the small battery is fully charged and that there is no load on the mains. Under these conditions the engine is at rest and there is no current flowing in the circuit. If, however, lamps are switched on which give rise to a load in excess of that which can be dealt with by the battery, the engine is started in the following manner: The current momentarily supplied by the battery passes through the series coil *A* of the relay, which is mounted on the switchboard. The effect of this is to cause the upper of the two contacts *C* to be pulled down so as to form a connection with the contact below it. Current then passes into the dynamo and causes the latter to act as a motor, and the engine is therefore run up to speed. To limit the starting current, however, a resistance switch is interposed in the circuit. This switch is fitted with a solenoid which gradually cuts out the resistance as in the case of a remote controlled electric motor. This starting resistance is to be seen at the point *A* in the general view. The starting current of the set is rather small, because while the engine is being run up to speed electrically the exhaust valve is lifted off its seat, and therefore no compression takes place. But when the arm of the starting switch reaches a certain

(Concluded on page 58.)

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Price Maintenance and Modern Merchandising—III

Price Protection Distinguished from Trust Control

By Louis D. Brandeis

[*ON May 14th, 1913, the Association of National Advertising Managers met at the Hotel Astor in New York and discussed the subject of price maintenance. One of the speakers was Mr. Louis D. Brandeis. In his address he very clearly showed why the maintenance prices on patented and trade-marked articles is not to be confused with the fixing of prices by a trust. The following is an abstract of his lucid presentation, slightly edited to give his remarks more the character of an article than of a speech.*

The problem discussed by Mr. Brandeis has been considered from another angle by Mr. Henry B. Joy, president of the Packard Motor Car Company. "An article is not sold until it is purchased by the consumer," says Mr. Joy. "When you sell a bill of goods to the wholesaler or retailer, that is merely a step in the process of sale, which you naturally should have a right to control. The selling in itself should and must include the right to control the intermediate agencies of sale between you and your real patron, the consumer. . . . The manufacturer must have the right to see that his goods reach the consumer with the least possible cost of intermediary processes. . . . Then will the goods reach the consumer at the least possible cost, which it is to the interest of the manufacturer that they should do."—EDITOR.]

I can conceive of nothing more prejudicial to the maintenance and extension of the right of a manufacturer to fix a selling price to the consumer than to rail generally against the provisions of the Sherman law, or against the attitude of the Government in endeavoring to enforce that beneficent statute.

The danger to business arises from the fact that men have failed to draw the distinction between a manufacturer fixing the retail selling price of an article of his own creation, and to which he has imparted his reputation, and the fixing of prices by a monopoly or by a combination tending to a monopoly.

If what is desired were the perpetuation of monopoly there would be no chance whatsoever, in my opinion, of preserving any existing right to make fixed selling prices, or of extending further that right, as I think it should be extended; for the American people are wisely determined to restrict the existence and operation of private monopolies.

The manufacturer's position is simply this: "That which is specifically mine, that which I create, and the good will which attends it—which was originally confined to my particular establishment, but now extends throughout the whole country, or perhaps throughout the whole world, that is my specific property; I have made it valuable to myself and I make it valuable to the consumer; because I have endowed that specific property with qualities on which everyone who purchases my goods may rely. That certainty is of value to the consumer, as it is of value to the maker."

Now, fixing prices under those circumstances has in it no element of monopoly. Operating as an independent manufacturer under competitive conditions, you fix the price at your peril. If you fix it too high, one of two things is likely to happen: either the community won't buy it, or, if it does despite the high price, some other person will come in and share your prosperity—so long as you have a field open to competition; and the price will fall if there is no combination. To so fix the ultimate selling price in a competitive business is not a restraint of trade in any proper case. On the contrary, it stimulates trade, because it gives an appropriate reward to the man who creates; and it is of the essence of trade to make as large as possible the rewards of successful creation. As long as we maintain conditions favorable to competition and the freedom of individual development—conditions which leave the individual's development untrammeled by superior power—so long may we safely allow men to take what profit they can get from an expectant public; and to exercise the largest degree of liberty in the marketing of their products.

But the moment that you endeavor by a combination of superior power to close the field to competition or to restrict individual effort; the moment that you take away from the people that protection which comes from the incentive in the individual to create, and in the opportunity of the customer to discriminate in his purchases (as you do when you close the avenues of competition) then a grave danger arises to progress, and it is against such danger that the Sherman law was appropriately directed. That statute seeks to protect the small man against the powerful trust—against the capitalistic combination. The Sherman law seeks to protect men in the right freely to compete, and to prevent practices which must result in suppressing competition. It seeks to preserve to the individual both the opportunity and the incentive to create; it seeks to encourage individual effort; and the right of an individual manufacturer in a competitive business to market his goods in his own way, by fixing, if he desires, the selling price to the consumer, is in entire harmony with the underlying purpose of the Sherman law. But when men combine to form a monopoly, or control a particular line or branch of trade, however good may be their intentions, they necessarily curb individual effort. Under the fundamental laws of human nature and of trade they withdraw incentive from those who enjoy the monopoly, and they narrow the field of human effort by confining leadership to a comparatively few individuals. And even where a complete monopoly does not exist, a powerful combination makes it so difficult for others to enter the field that most men are practically barred by the great chances of failure in entering upon so unequal a contest. It is against such conditions that the Sherman law was directed. That is, the true restraint of trade—restraint through monopoly or combinations tending to monopoly, a condition under which business success is at best temporary, is often delusive and is always purchased at the expense of the community.

Now I take it that the effort which was made in Congress last year to limit further the right (as it now exists in respect to patented articles) to fix selling prices to the ultimate consumers and which finds expression in Section 2 of the Oldfield bill proceeds from an admirable motive. But though the motive is good and the purpose worthy, the course pursued is a mistaken one. And the mistake arises from the failure to recognize that certain hardships inflicted by conspicuous trusts which do fix prices, have not arisen from the fixing of the wholesale or retail prices, but from the fact that a monopoly or combination existed which made it possible to fix those prices at an unreasonably high figure. In other words—it was not the fixing of the price, but it was the power of the great trust behind the price-fixing which was the cause of the hardship which it is vainly sought to remove by Section 2 of the Oldfield bill. And the way to remove both the community's anxiety over price-fixing, and your anxiety over the effort to limit that right, is to suppress private monopolies and combinations of like character.

Make clear the distinction between that monopolizing, which the Sherman law seeks to prevent and to extinguish, and that price-fixing which is an incident of the individual development of business and the building up of reputations of goods as of individuals—take up the work of education on those lines, and you will, I am convinced, succeed and ultimately will get such wise legislation as Denmark has given to her people on this subject.

PATENT ATTORNEYS

PATENTS

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Inquiry No. 9310. Wanted addresses of manufacturers of good selling articles for mail order business catering to the trade of agents.

Inquiry No. 9311. Wanted names and addresses of manufacturers of hatpin heads made of colored glass; also medals of all shapes.

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvas.

Inquiry No. 9318. Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

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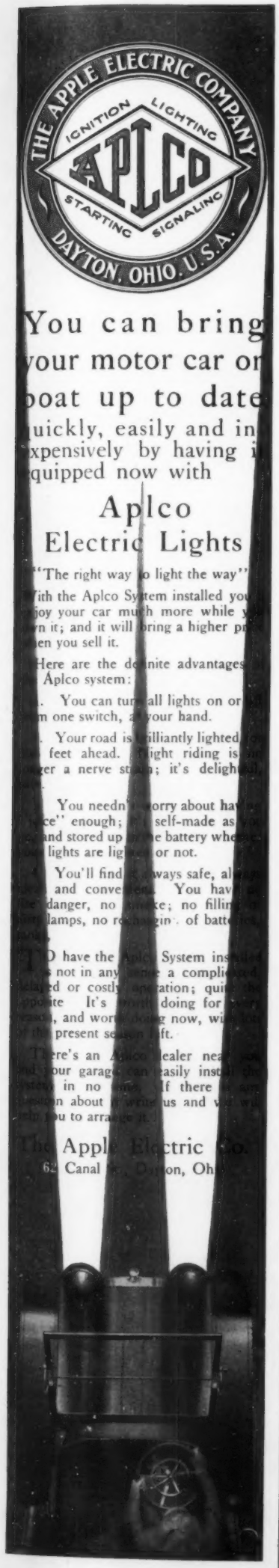

Purifying Water by the Action of Ultra-violet Light

(Concluded from page 48.)

ter over and over again to the same lamp, or by passing it successively into the luminous zone of several lamps. Besides, the apparatus must be so constructed that the water, while under the influence of the light, is stirred up so as to turn over and over microscopic suspended matter which might have escaped filtration and which might screen microbes from the light.

A typical European sterilizer is to be found in one of the suburbs of Rouen, France. For over two years this installation has supplied water sterilized by ultra-violet rays. Since the introduction of the system not a single typhoid case has been known among the subscribers, whereas the percentage of typhoid cases in neighboring districts is appreciable.

The most recent types of sterilizing apparatus are characterized chiefly by the fact that they use the light in a more economical way than any apparatus hitherto constructed. The principles involved are such that the construction of very large sterilizing units is possible.

The apparatus consists of a tank or long canal through which the water flows. Baffle plates are interposed to stir up the water as it flows. Into the walls of this tank are inserted at intervals of several feet, quartz tubes fitted water-tight to vertical plates constituting part of the walls of the sterilizing tank. These quartz tubes are about two inches in diameter and eight inches long, and are closed at the end. The vertical plates are provided with external metal boxes which carry the lamp supports. The lamps are not unlike a pistol in shape and are characterized by a very narrow U-shaped luminous tube, of such length and diameter that it nearly fills the two-inch quartz tubes. All the light produced by these "pistol" lamps therefore enters the water through these quartz tubes, whereas the lamp itself is protected from contact with the water by these same tubes. This is of importance, because the production of ultra-violet rays in quartz mercury vapor lamps is more economical the higher the temperature of the tube (the lamps usually run at a temperature of about 800 deg. Cent.). It is, therefore, necessary to prevent the lamps from touching the water, which would cool them down to such an extent that the production of ultra-violet rays would be very low and uneconomical.

The sterilizing canal is equipped with a maximum of twelve such lamps, each using 1,500 watts. One of the installations has been running for eight months and sterilizes the water in a municipal plant at the rate of 1,700,000 gallons per day. Most of the time only a few of the lamps are illuminated.

In larger water plants, several such canals may be operated in parallel. If the unit is small fewer lamps, even only a single one, may be employed and the sterilizing tank reduced correspondingly in size. In the latter case the baffle plates must be so arranged that the water is led several times near the single source of light.

The small apparatus illustrated in the accompanying engraving has been used for military work as a field sterilizer. The complete equipment in this case, mounted on a gun carriage, consists of a gasoline motor generator set, water pump, filter, and the ultra-violet ray sterilizer.

A similar outfit has supplied water to a field hospital during the French-Morocco campaign where it has been in constant use for nearly two years for supplying water for drinking and surgical purposes. The report by the surgeon in charge states that there has been no case of hospital infection or typhoid during all this time, proving thereby the utility of this sterilizing apparatus.

It is evident that the application of ultra-violet rays in water purification has developed into an industry which promises to do away with the disastrous effect of the many maladies which are spread by the water.

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GRAND RAPIDS, : : MICHIGAN

An Automatic Electric Light Plant

(*Concluded from page 55.*)

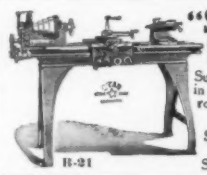
position the exhaust valve is released and compression therefore occurs at the proper intervals. The dynamo then ceases to act as a motor. As the speed rises the dynamo commences to take up the load and to put current into the battery. If, however, the load is light, say, a load of two or three lamps, the engine is not started when the lamp switches are closed, for the current needed for such a load can easily be supplied by the battery. When such a small current is passing through the coil *A* of the relay, the magnetism produced is sufficient to draw the contact *C* downward, and consequently the engine remains at rest. But after these two or three lamps have been burning for a certain period the voltage of the battery naturally begins to fall, and ultimately the pressure at the terminals attains a value which renders further discharge undesirable. At this point it is necessary for the engine to be started. To enable this to occur the relay is also fitted with a shunt coil *B*, which is connected across the terminals of the battery. Obviously, as the voltage of the battery falls the magnetism produced by this shunt coil diminishes. When this occurs the spring on the left of the relay lifts the shunt magnet so that the lower contact rises and touches the contact above it. This also causes current from the battery to be supplied to the dynamo, when the latter acts as a motor. The engine is then run up to speed and charging takes place in the manner already described. It will be seen that the plant is absolutely automatic in action and the engine is started and stopped according to the demand for the load and the condition of the battery. There is one trouble which might arise if the engine were allowed to run short of gasoline or if the ignition system failed to operate. Clearly under these conditions the plant might be driven by the battery until the cells were exhausted, this having anything but a beneficial effect upon the battery. To prevent such an occurrence, however, a time limit circuit breaker is provided on the switchboard. This breaker will allow a motoring current to pass for a given period only, after which it interrupts the circuit. The breaker not only eliminates the possibility of the battery's being discharged in the manner described, but also cuts off the current in the event of the plant's being overloaded.

The Current Supplement

IN this week's issue of our SUPPLEMENT R. T. Mohan writes on the scientific advancement of the canning industry.—A. H. Brown describes an automatic astronomical calculator, which replaces long and tedious tabular computations by simple automatic mechanical operations.—It is well known that the manufacture of white lead is fraught with danger to the health of the workmen. A sanitary system of handling white lead is described and illustrated.—A very important article appearing in this issue is a discussion of "The Principles of Fuel Oil Engines," by Prof. C. F. Hirschfeld.—H. Passavant writes on the uses of artificial insulating materials in the construction of electrical apparatus.—G. Gilmour contributes an article on Safety Engineering.—Another subject dealt with is the mechanical design of switches.—The average cost of killing a man in war is $15,000. Contrast with this the cost of saving a human life by strict attention to sanitary requirements in the canal zone: $2.43. This is one of the points brought out in an article on Life Preservation.

A Method to Prevent Tarnishing of Silver

A SIMPLE and admirable method of preventing the tarnishing of silver while not in use is suggested by *La Revue de Chimie Industrielle*. It consists in rubbing the articles with alcohol in which a little collodion has been dissolved. A very delicate protective film is thus formed on the surface. This film is easily removed by washing with warm water when the object is again required.



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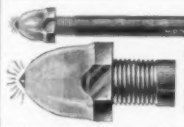
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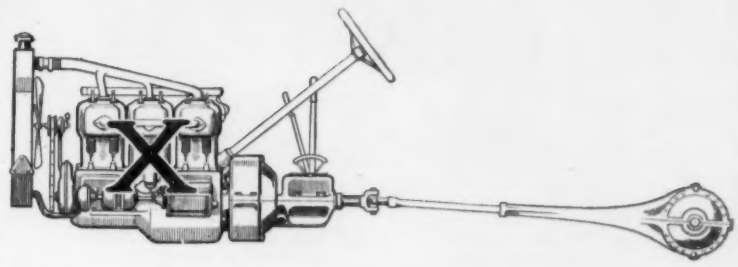
(12828) B. K. asks: 1. If a 100,000-ohm D. C. voltmeter, 60-volt scale is connected across 110-volt A. C. circuit, will the magnet be weakened or injured in any way? A. We should not expect a D. C. voltmeter of 100,000 ohms to be affected by an A. C. current. The winding of the voltmeter is on the movable coil, and the field magnet would hardly be demagnetized in the short time the voltmeter would be ordinarily connected across the circuit. If, however, the connections were left closed for a long time, the magnet might be weakened by the alternating current. 2. In the event of a powerful wireless station being within a quarter of a mile distance of a reflecting galvanometer which is used for testing submarine cable, would the deflections be affected by the sending apparatus of the station? A. It is improbable that a reflecting galvanometer would receive the waves of a wireless telegraph station. We have never heard of such a case. The test is the experiment, however, and we would not say that it is impossible.

(12829) B. M. M. asks: It is an old saying that black colors draw the heat, and some say they absorb heat, etc. Now, is it a fact that a tank of a given size filled with water will get hotter (the water) by the rays of the sun in a tank painted black than one of the same dimensions left unpainted, being of a bright color? I mean in the same time. A. In general, it may be said that water in a tank of metal which is black in color will become hotter in the sun than if the tank were of a bright color. If the tank is of wood there will be less heating of the water, since the wood is a non-conductor of heat. A black surface absorbs heat more readily than a bright surface; so too, a rough surface absorbs he.t more readily than a smooth one.

(12830) W. D. asks: Does a vapor have the same properties as a gas? A. A vapor is a gas which is near the temperature at which it will become a liquid, either by cooling or by compressing it, or both. A gas cannot be liquefied by pressure alone. Both may be the same substance at different temperatures. A vapor may be defined as an easily liquefiable gas. Every gas has a temperature above which it is impossible to liquefy it by pressure alone. Both cooling and pressure are required for its liquefaction. This temperature is called the Critical Temperature. Your question may now be answered that a vapor has some properties different from those of the same substance as a gas. See Carhart's "College Physics," page 385, price, $2.50 postpaid. 2. Is viscosity a property of gases, and especially of hydrocarbon gases? Pentane, hexane and heptane are 2½, 3 and 3½ times heavier than the atmosphere, and sink to earth by their own gravity. Could you tell me how long it takes for these gases to diffuse, and if there is viscosity in these gases, is it opposed to diffusion, and does viscosity cause the gases to follow in channels rather than to disseminate uniformly along the ground? A. Viscosity in a small degree is a property of all gases, unless h drogen be an exception. Cohesion is also a property of all gases excepting hyd.ogen. We doubt if the hydrocarbon gases are very peculiar in this respect. Viscosity would be opposed to diffusion, but all gases diffuse readily, as may be seen by the short time required for the odor of a gas to reach a point several feet away in a closed room free from drafts. We cannot give any figures as to time required to travel a measured distance.

(12831) W. C. McN. writes: In your query number twelve thousand eight hundred and eighteen, in reply to J. T., referring to benzol as a corrector for heavy oils for use in oil engines, are you not mistaken when you state that benzol and benzine are the same thing? My impression is that benzol is a definite chemical compound C_6H_6 B.P. 80.1 deg. Cent., derived from coal tar, while benzine is one of the lighter fractions of petroleum and a mixture of hydrocarbons. A. The error in the note No. 12818 is due to a momentary confusion between benzene and benzine, the former of which is the same as benzol, and the latter is the one which is nearly the same as gasoline. Benzene is C_6H_6 as you say, and is a coal tar product, while gasoline is a petroleum distillate. We thank you for calling attention to the error. It would be well if one of these words, with the same sound but very dissimilar meanings, could disappear from the language of chemistry. If benzene were displaced by benzol or benzole, both of which are to be found in use, we should then have to look out for benzolin, benzil, benzoin, benzoyl, benzyl, benzal, benzin, and its other spelling, benzine, benzein, not to speak of benzanilide, benzhydrol, benzidine, benzilam, and benzidam, whose name suggests the state of mind which such a series of names is well adapted to produce. There seems to be a just claim for forgiveness for our slip and fall between these two words.

Lost power means worn metal



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Most of the power lost on the way is taken up by friction.

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Only oil whose ***"body,"*** *or thickness, is suited to your feed system can properly reach the friction points.*

Correct *"body"* is quite as important as correct *quality.*

And correct "body" cannot be determined by guess.

Motor-constructions differ widely. Before the correct "body" for your feed requirements can be determined, the construction of your motor *must* be known and carefully considered.

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The correct oil for each car we then specify in a lubricating chart (printed, in part, on the right).

The oils specified have extraordinary wearing qualities and will retain an efficient lubricating "body" under the most exacting service demands. Their "body" suits the feed requirements of each car they are recommended for.

The lubricating chart in this page represents the professional advice of a company whose authority on scientific lubrication is unquestioned the world over—The Vacuum Oil Company.

If you use oil of lower lubricating ***quality*** *or of less-correct* ***"body"*** *than that specified for your car, your motor must face loss of power, unnecessary friction, and ultimate serious damage.*

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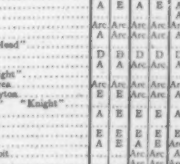
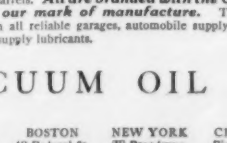


Correct Lubrication

SMOOTHEST OPERATION | MOST POWER | FEWEST REPAIRS | LONGEST LIFE

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example: "A" means "Gargoyle Mobiloil A." "Arc." means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil A. The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1909 Summer	1909 Winter	1910 Summer	1910 Winter	1911 Summer	1911 Winter	1912 Summer	1912 Winter	1913 Summer	1913 Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Apperson	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	E	A	Arc.	A	Arc.		
Avery			A	E	A	E	A	A	A	A
Benz	A	A	A	A	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A	A	A
" (4 cyl.)	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (1 cyl.)	B	A								
" (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	A	A	E	A	E	A	E	A	E
" Com'l.	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
Case					A	A	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Chase	B	B	B	B	B	B	B	B	B	B
Cole			Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Columbia	A	E	E	E	A	A				
" "Knight"							A	A	A	A
Couple Gear	A	A	A	A	A	A	A	Arc.	A	Arc.
Daimler	A	E	A	E	A	E	A	A	A	A
" "Knight"							A	A	A	A
Darracq	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
De Dion	B	A	B	E	B	A	B	A	B	A
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
Elmore	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.		
Fiat	B	A	A	A	B	A	A	A	B	A
Flanders			E	E	E	E	Arc.	Arc.		
" (6 cyl.)									Arc.	Arc.
Ford	E	E	A	Arc.	E	E	E	E	E	E
Franklin	B	E	B	A	B	A	Arc.	A	Arc.	A
" Com'l.	B	A	B	A	B	A	A	Arc.	A	Arc.
G. M. C.							Arc.	Arc.	A	Arc.
Grabowsky									B	A
Grant									A	A
Grant-Logan	A	Arc.	A	Arc.						
Herreshoff	A	A	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Hewitt (2 cyl.)	A	A	A	A	A	Arc.				
" (4 cyl.)	A	A	A	E	A	E	E	E	E	E
Hudson			Arc.	Arc.	A	Arc.				
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" "32"									A	Arc.
I. H. C. (air)									B	A
" (water)									A	A
International	B	A	B	A	B	B	B	A		
Interstate	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Isotta	A	A	A	A	A	A	A	A	A	A
Itala	A	A	A	A	A	A	A	A	A	A
Jackson (2 cyl.)	A	A	A	A	A	Arc.				
" (4 cyl.)	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Kelly					Arc.	Arc.	Arc.	Arc.		
Kelly Springfield									Arc.	Arc.
Kissel-Kar	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
" Com'l.					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kline Kar			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Knox	B	A	B	A	A	A	B	A	B	A
Krit			A	A	A	A	A	A	A	A
Lancia	B	A	B	A	B	B	Arc.	B	Arc.	B
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Mack	A	E	A	E	A	E	E	E	E	E
Marion	A	E	A	E	A	E	A	A	A	A
Marmon	Arc.	Arc.	A	E	A	Arc.	A	Arc.	A	Arc.
Matheson	Arc.	Arc.	Arc.	Arc.	A	A	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	E	E		
" (4 cyl.)	E	E	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)									Arc.	Arc.
Mercedes	A	E	A	E	A	E	A	E	A	E
" "Knight"					A	A	A	A	A	A
Mercer			A	Arc.	A	Arc.	A	Arc.	A	Arc.
Michigan			Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Minerva "Knight"					A	A	A	A	A	A
Mitchell	A	A	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Moon	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
National	A	Arc.	A	A	A	A	A	A	A	A
Oakland	A	E	A	E	A	A	A	A	A	A
Oldsmobile	A	E	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.
Overland	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Paige Detroit			E	E	A	Arc.	A	E	A	E
Panhard	A	E	A	E	A	E	A	A	Arc.	A
" "Knight"					A	A	A	A	A	A
Pathfinder									Arc.	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
" Com'l.					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Pullman	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Rambler	A	A	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.
Rapid	A	A	A	A	A	Arc.	Arc.	Arc.		
Rayfield							A	A	A	A
Regal	A	E	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
S. G. V.					B	Arc.	B	Arc.	B	Arc.
Selden	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
Service					A	A	A	Arc.	A	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" "Mead"									A	Arc.
Stanley	D	D	D	D	D	D	D	D	D	D
Stearns	A	A	Arc.	Arc.	A	Arc.				
" "Knight"							A	A	A	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	E	E	Arc.	Arc.	A	A	A	A	A	A
" "Knight"							A	A	A	A
Studebaker	A	E	E	E	A	Arc.	Arc.	Arc.	A	Arc.
Stutz							Arc.	Arc.	Arc.	Arc.
Thomas	E	E	E	E	E	E	A	E		
Walter	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Warren Detroit			Arc.	Arc.	A	A	A	A	A	Arc.
White (Gas)			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (Steam)	D	D	D	D	D	D	D	D	D	D
Winton	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.



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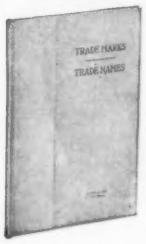

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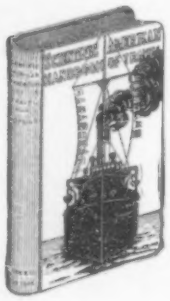

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